Supplement to Current Science

Current Science, Vol. XXXIX, 1970

Author Index

PAGE

ABD-EL-WAHAB, F. K. 552
Abraham, V. 330
Abrol, Y. P. 421
Abou Aziz, A. B. 552
Adinarayana Murty, A. 132
Agarwal, Hari C. 551
Agnihothrudu, V. 121
Agrawal, D. P. 219
Alagarswami, K. 186
Allag, I. S. 55
Ambwani, K. 241
Anahosur, K. H. 286
Anand, R. C. 279
Anand, S. K. 94
Anantaraman, M. 199
Anantha Iyer, G. V. 359
Ananthakrishnan, R. . 101, 248, 386
Ananthakrishnan, T. N. 297, 507
Anantharaman, T. R. .. 123, 335 477
Anjali Roy. .. . 258
Anjaneyulu, Y. V .. 39
Appaswamy Rao, M. 184
Apte, R. G. 491
Aravamudan, G. . 84, 206, 230, 370
Aruldhas, G. . .. 204
Atwal, S. S. 339
Awasthi, D. D. . 441
Awasthi, M. N. .. 229
Ayyakkannu, K . 327, 398

BABU, C. R. 288
Babu Rao, K. 10
Babu, S. K. 154
Balakrishnan Nair, N. . 135, 545
Balasundaram, V. R. .. 328, 491
Baldev, B. 319
Banerji, K. K. 369
Barsal, H. C. 494
Baruah, G. D. 405
Batta, A. K. 416
Bharadwaj, S. D. 43
Bhargawa, H. D. 62
Bhargawa, V. K. 466
Bhaskara Rao 121
Bhaskar Rao, T. 112
Bhaskara Sarma, P. V. R. 371

PAGE

Bhat, U. K. M. 388, 488, 537
Bhatt, D. C. 331
Bhatnagar, V. M. 132
Bhattacharjee, A. J. 280
Bhattacharyya, J. P. 378
Bilgrami, K. S. 16
Biswas, M. C. 288
Borooah, S. K. 436
Bose, Paromita 542
Buche, V. V. 511

CHACKO, E. K. 271, 530
Chakravarti, M. R. 283, 516
Chakraverty, R. K. 472
Chakravorty, S. R. 512
Chand, J. N. 498
Chandramohan, D. 327, 398
Chandrasekhara Raju, P. 556
Chandrasekhara Rao, G. .. 251, 504
Chatterjee, D. N. 512
Chatterjee, S 468
Chattopadhyay, S. K. 187
Chaturvedi, H. C. 128
Chauhan, A. K. S 42
Chawan, D. D. 401
Chellappa, D. J 199
Chetal, A R. 391
Chincholkar, V. S. 348
Chinnadurai, G. 165
Chinnayya, B. 257
Chopra, Suman 17
Chothia, D. S. 322

DANI, H. M. 55, 235
Darshane, V. S. 36
Das, A. K. 60
Das, B. 339
Das, K. 494
Dasgupta, P. R. 467
Dash, B. 560
Dass, H. C. 530
Dastidar, P. R. 321
D'Cruz, R. 498
Desai, D. M. 464
Desai, M. V. M. 429
Deshmukh, G. S. 181

PAGE

Deshmukh, K. G. 368
Deshpande, G. G. 516
Deshpande, P. D. 36
Deshpande, S. M. 372
Deshpande, V. V. 36
Devadath, S. 420
Dev Rao 18, 117, 141, 214
Dharmendra Nath 325
Dhingra, O. D. 498
Dhir, R. P. 211
Dighe, (Miss) V. S. 253
Dinesh Kumar 14, 458
Dube, S. D. 446
Dubey, D. S. 152, 367
Durgaprasada Rao, N. V. N. 225
Dutta, Shipra 444
Dwivedi, P. C. 107

EBENEZER, LILY N. 68
El-Gobashy, A. S. 341

FAQUIH, F. M. 61
Foda, H. A. 341

GANAPATI, P. N. 12
Ganesan, R. 36
Ganga Devi, N. 37
Gangrade, G. A. 15
Ganguly, A. K. 429, 501
Ganguly, B. 191
Garcha, J. S. 269
Gharpure, M. B. 29, 73
Ghosh, Maya 467
Ghude, S. H. 548
Gill, B. S. 445
Girishwar Nath 126
Goel, S. C. 518
Gogate, S. S. 171
Gogte, B. S. 515
Gohal, M. S. 362
Gopal, N. H. 44
Gopalakrishna, A. 309, 436, 489
Gopalakrishnan Nair, B. 209
Gopinath, D. M. 410
Gopinathan Pillay, N. 188, 260
Govindaswamy, G. V. 308
Goyal, J. P. 287
Guha, Sipra 174
Gundu Rao, C. 156, 373
Gupta, B. S. S. 511
Gupta, H. P. 236
Gupta, K. C. 40
Gupta, M. P. .. 131, 152, 346, 367
Gupta, N. 174
Gupta, R. C. 264
Gupta, R. M. 107
Gupta, S. K. 219
Gupta, S. R. 138
Gupta, U. S. 69
Gupta, V. P. 137, 237, 399, 535, 536

HANUMANTHA RAO, K. 563
Haranath, P. B. V. .. 10, 132, 228, 344
Hariharan, P. V. 230
Harihar Singh 234
House, L. R. 544

INAMDAR, J. A. 331
Indira Chary, C. A. 276
Ingle, S. G. 368
Iswaran, V. .. 93, 328, 400, 491
Iyer, C. P. A. 271
Iyer, R. D. 174

JADHAV, A. S. 498
Jagadiswara Rao, R. 417, 562
Jagdev Singh 182, 360
Jahuri, K. S. 93, 400
Janaki Ammal, E. K. 330
Jayaraman, Kunthala 91
Jayarama Reddy, P. 301
Jesthi, P. K. 417
Jeswani, L. M. 518
Joglekar, Asha 67
Johny, K. P. 63
Johri, B. M. 177
Jolly, M. S. 423
Jolly, (Miss) Prem 211
Joseph, K. T. 105, 145
Joshi, D. M. 396
Joshi, G. T. 332
Jurand, A. 518

KALE, A. J. 58
Kale, P. P. 180
Kalia, Prabha 355
Kalloo 494
Kalra, D. S. 440
Kalyanam, N. P. 66
Kamalesh Kumari (Miss) .. . 240
Kameswara Rao, K. 87
Kameswara Rao, T. 529
Kannabiran, B. 262
Kapoor, I. J. 140
Kapur, M. P. 440
Kar, A. B. 467
Kartha, K. K. 263, 539
Kasturi, K. 434
Kathju, S. 46

PAGE

Kaul, Parmil 69
Kawatra, B. L. 269
Khan, M. A. 438
Khan, S. H. 86
Khan, S. U. 339
Khandekar, R. N. 49
Khara, M. N. 498
Kishore, H. 94
Knypl, J. S. 534
Koshy, M. M. 353
Kothandaraman, H. 532
Kotwal, S. N. 285
Krishnamoorthy, T. M. 171
Krishnamurthy, A. S. 410
Krishnamurthy, K. H. 262
Krishnamurthy, K. V. 410
Krishna Murti, G. S. R. 211
Krishnan Nambisan, P. N. 348
Krishna Rao, K. V. 561
Krishna Rao, M. 360
Krishna Rao, N. V. 392
Krishna Rao, R. V. 134, 374
Krishnaswamy, N. 62
Kulkarni, L. G. 259
Kumbhojkar, M. S. 567
Kurup, N. G. 149
Kusumgar, Sheela 219

LAKSHMI, (Mrs.) T. G. 395
Lakshminarayana, A. 228, 344
Lal, A. 33
Lal, B. M. 518
Lal, S. B. 188, 260
Lalithakumari, D. 308
Lambert Isaac, M. P. 352
Lerbscher, J. A. 561
Likhite, S. D. 313
Lodha, B. C. 305

MACHWE, M. K. 412
Madhyastha, M. N. 439
Mahadevan, V. 37
Mahapatra, S. K. 560
Maheshwari, R. C. 435
Maheswari Devi, H. 376
Majumder, P. K. 142, 409
Malhotra, J. C. 538
Malhotra, S. L. 477
Mallikarjuna Swamy, K. 299
Mandal, S. N. 280
Mande, C. 391
Manmohan Singh 83
Mathew, Elizabeth 429
Mathur, K. C. 167
Mathur, P. B. 187

PAGE

Mathur, P. K. 538
Matta, K. L. 279
Mehrotra, R. K. 215, 522
Mehrotra, S. N. 538
Mehrotra, T. N. 303
Mehta, D. A. 513
Mehta, M. L. 229
Merchant, J. R. 322
Mishra, B. M. 386
Misra, B. S. 111
Misra, J. P. 88
Misra, R. C. 190
Misra, S. P. 417
Mitra, G. C. 128
Mohan, S. 301
Mohanty, B. S. 300
Mookerjee, S. 468
Mukherjee, R. N. 352
Mukherjee, S. K. 409
Mukherjee, S. L. 253, 464
Mullick, S. G. 111
Muraleedharan, N. V. 281
Muralirangan, M. C. 297, 507
Murti, V. V. S. 553
Murty, P. S. N. 30

NAG, K. K. 177
Nagarajan, (Miss) R. 436
Nagarkatti, Sudha 76
Nageswar, S. 483
Nageswara Rao, G. 462
Naik, S. M. 470
Nair, A. G. R. 323
Nair, K. N. 352
Nam Prakash 539
Nanda, D. P. 300
Narasaraju, T. S. B. 277, 415
Narasimhan, R. 28, 521
Narayanan, P. 147
Narayanan, S. 232
Narayanan Kutty, T. R. .. 322, 359
Narayanaswamy, M. 356
Nariani, T. K. 263, 539
Naseem, S. M. 86
Natarajan, B. V. 497, 521
Natarajan, P. 545
Natarajan, S. 533
Nath, M. C. 281
Nath, P. 369
Nath, S. 405
Navaneethakrishnan, P. 14
Nayar, K. K. 256
Nayar, N. M. 362
Nayudu, M. V. 495

PAGE

Neelakantan, S. 85
Neelameghan, A. 511
Nerkar, Y. S. 274
Nevagi, S. A. 184

OBLISWAMI, G. 91

PADHYE, M. D. 261, 377
Padmanabhan, V. M. 181
Pal, S. C. 111
Paliwal, G. S. 19
Pande, B. P. .. 325, 399, 535, 536
Pande, J. K. 467
Panduranga Rao, V. 210, 371
Pant, D. D. 510
Pant, H. C. 510
Panwar, K. S. 422
Parameswaran, M. 105, 145
Parameswaran Pillai, P. 78
Pardhasaradhi, Y. J. 10
Parekh, L. J. 513
Parekh, M. G. 349
Patel, N. M. 253
Patel, R. C. 331
Patil, D. R. 436
Patil, P. V. 348
Patwardhan, P. G. 332
Paul Jayaraj, A. 213
Paul, P. K. 158
Perumal, M. C. 186
Phadke, A. V. 65
Phalak, V. R. 375
Phansalkar, R. B. 309, 489
Pichamuthu, C. S. 245, 383, 525
Pillai, M. K. K. 551
Pillai, T. N. V. 501
Poornachandra Rao, M. 225
Powar, K. B. 516
Prabhoo, N. R. 490
Prakasa Rao, N. S. 207
Prasad, B. N. 215, 444, 522
Prasad, N. N. 304
Prasad, R. 353
Prasad, S. M. 131, 146
Prasad, Y. V. R. K. 97
Prasada, R. 287
Prema, B. V. 356
Premswarup, D. 253
Puri, R. P. 274
Purkayastha, R. P. 307
Purohit, A. K. 419
Purohit, D. K. 16
Purushotham, D. 486
Purushothaman, D. 304

PAGE

QAYYUM SIDDIQUI, A. 86

RADHAKRISHNAMURTY, C. 313
Radhakrishnan, J. 347
Raghavan, A. 302
Raghavan, N. G. S. 135
Raghunathan, A. N. 418
Ragunathan, V. 44, 304
Raghukumar, S. 90
Raghuvanshi, S. S. 42
Rahman, S. Abdul 356
Rai, J. N. 435
Rai, M. M. 344
Raina, A. K. 189
Rajagopal, T. 201, 363
Rajagopal, V. 443
Rajale, G. B. 211
Rajasekaran, S. 22
Rajendra Babu, M. 110
Rajendra Prasad 211
Ram, C. B. 446
Ramachandran Nair, C. G. .. 209, 348
Ramachandra Rao, B. 413
Ramachandra Rao, V. 486
Ramachandra Row, L. 207
Ramadas, S. R. 347
Ramaiah, T. R. 7
Ramakrishna, T. 160
Ramakrishna Rao, G. 59
Ramakrishna Udupa, M. 206
Ramakrishna, Y. S. 59
Ramakrishnan, K. 418
Ramamurty, M. 225
Raman, Sir C. V. 1, 25
Raman, Sir C. V. (Photograph) .. 525
Raman, K. P. 396
Ramana Rao, D. V. 60, 371
Ramana Rao, K. L. V. .. 10, 382
Ramana Rao, M. V. 563
Ramana Rao, V. V. 204
Rama Rao, K. 396
Ramashanker 65
Ramaswamy, A. S. 533
Ramaswamy, A. V. 316
Ramaswamy, C. 291
Ramayya, N. 201, 363
Ramdas, L. A. 454
Ramesh Narayan 51
Rameshwar Singh 113
Ramu, T. C. S. 400
Ram Udar, ... 14, 458
Randhawa, G. S. 530
Rangaswamy, G. 91
Rangaswami, S. 209, 416
Rangneker, P. V. 439

PAGE

Rao, Ch. M. 30
Rao, D. C. 161
Rao, D. V. K. 153, 392
Rao, I. M. 443
Rao, J. T. 497
Rao, L. N. 239
Rao, M. V. R. 435
Rao, N. G. P. 544
Rao, P. R. 212
Rao, S. R. V. 81
Rao, V. L. N. 415
Rao, V. R. S. 83, 370
Rao, Y. P. 216, 330
Rao, Y. S. 162
Rathore, D. S. 142
Ratnasamy, P. 316
Ravindran, K. 321
Ravindran Nair, K. 322
Ravindranatha Menon, N. .. 135, 238
Raychaudhuri, S. P. 191, 541
Reddi, T. G. 281
Reddy, B. R. K. 485, 509
Reddy, C. M. 38
Reddy, G. V. G. 30
Reddy, Y. P. 485
Roy, J. K. 162
Roy, R. Y. 43
Roy, S. K. 264
Royan, J. P. 14
Rui D'Cruz 498

SADASHIVAIAH, M. S. 226
Sadasivan, G. 68
Sadasivan, T. S. 27
Sah, J. P. 273
Sahai, B. N. 13
Sahasrabudhe, J. D. 489
Sahu, B. N. 346
Sahu, R. C. 190
Saini, H. S. 55, 235
Saini, S. S. 235
Saksena, R. K. 278
Salama, H. S. 497
Saleh, M. 497
Sambamurthy, K. 110
Sampath, S. 162
Sampathkumar, R. 285
Sankara Rao, V. S. 181
Sankara Rao, C. 372
Sankara Subramanian, S. 323
Sankhla, N. 354
Santani, Smt. S. B. 49
Santappa, M. 302, 532
Sanyal, R. 183

PAGE

Sanyasi Raju, P. T. 413
Sapre, V. B. 391
Saramma Abraham 115
Sareen, K. 55, 235
Sarma, M. S. 378
Sarma, P. N. 133
Sarma, V. S. 259
Sarma, Y. R. 495
Sastri, C. S. 229
Sastri, M. V. C. 109, 407, 559
Sastry, D. H. 97
Sastry, V. N. 171
Sathianandan, K. 58
Satyanarayana, K. G. 335
Satyanarayana, K. V. S. 211
Sathyanesan, A. G. 350
Saxena, G. N. 339
Saxena, H. P. 189
Seetharam, A. 492
Seetharama, N. 166
Seetha Rao, K. 11
Sehgal, C. B. 19
Sehgal, S. S. 551
Sellars, C. M. 548
Selvakumar, R. A. 481
Selvaraj, A. M. 14
Sen, David N. 116, 401
Sen, S. K. 423
Seshadri, C. V. 562
Seshadri, T. R. 533
Seth, M. L. 541
Setty, T. H. V. 483
Shah, D. O. 462
Shah, N. L. 487
Shanta, P. 188, 260
Shanta Venkata Raman 147
Sharda, R. T. 94
Sharma, B. C. 191
Sharma, K. D. 401
Sharma, N. K. 82
Sharma, R. K. 182
Sharma, Rameshwar, K. 466
Shinde, V. A. 303
Shivaling Reddy, B. 214
Shiv Prakash 518
Shome, S. K. 135
Shreemali, J. L. 378
Shrivastava, P. C. 451
Shukla, (Miss) Jaya V. 344
Shukla, M. M. 345
Siddiq, E. A. 274
Siddiquie, H. N. 451
Singh, B. B. 163
Singh, D. V. 541
Singh, Gurkipal 469

PAGE

Singh, I. D. .. 345
Singh, K. B. .. 265
Singh, K. P. .. 441
Singh, K. R. P. .. 388, 488, 537
Singh, R. P. .. 277, 372, 415
Singh, R. P. .. 20, 216, 330
Singh, Tejinder P. .. 265
Singh, S. N. .. 355
Singh, V. K. .. 187
Singhania, D. L. .. 544
Sinha, R. K. .. 183
Sinha, S. S. .. 423
Sipra Guha .. 174
Sita Manikyam, (Mrs.) D. .. 463
Sitaramaswamy, P. .. 299
Sivaji, Ch. .. 153
Sivaramakrishnan, V. .. 229
Sivasithamparam, K. .. 493
Soman, S. D. .. 145
Somasekhara, S. .. 253, 464
Sreekumaran, C. .. 105
Sreeramulu, N. .. 443
Srimannarayana, G. .. 133, 395
Srinivasachar, D. .. 492
Srinivasan, R. .. 130
Srinivasan, V. .. 109, 407, 559
Srinivasan, V. K. .. 19
Srinivasan, V. S. .. 254
Srivastava, G. N. .. 566
Srivastava, M. L. .. 273
Srivastava, M. M. .. 461
Srivastava, P. S. L. .. 19
Srivastava, S. C. .. 14, 458
Srivastava, S. S. .. 350
Subba Rao, B. V. S. S. R. .. 12
Subba Rao, K. .. 556
Subba Rao, M. .. 529
Subba Rao, N. S. .. 491
Subba Rao, N. V. .. 133, 395
Subbarayadu, G. V. .. 226
Subrahmanya Sastry, P. .. 253
Subramaniam, M. K. .. 40
Subramaniam, M. D. .. 271
Subramanian, C. V. .. 2, 28
Sukumara Pillay, K. R. .. 356
Sundaram, E. V. .. 463
Sundaram, S. .. 394
Sundara Rajulu, G. .. 324, 397, 565
Sundararamaiah, T. .. 372
Sundara Rao, W. V. B. .. 93, 328, 491
Suresh, K. S. .. 65
Suryanarayana, C. .. 123
Suryanarayana, D. .. 240
Swaminathan, K. .. 394
Swaminathan, M. S. .. 174, 319

PAGE

TALWAR, P. K. .. 67
Tamhane, D. V. .. 38, 434
Tandon, R. N. .. 140
Tare, M. P. .. 396
Tewari, M. N. .. 46
Thappa, R. K. .. 182
Tharanathan, R. N. .. 39
Thothathri, K. .. 353
Tikekar, R. S. .. 460
Tiruvenganna Rao, P. .. 153, 392, 485, 509
Tiwari, S. N. .. 477
Tripathi, D. N. .. 405
Tripathy, D. .. 190
Trivedi, B. S. .. 88, 241, 442
Trivedi, K. N. .. 349
Trotter, J. .. 561

UDUPA, M. R. .. 84, 230
Unnikrishnan Nayar .. 204
Untawale, A. G. .. 261
Upadhya, K. N. .. 344
Upadhya, M. D. .. 94
Upadhyay, R. R. .. 372
Uprety, D. C. .. 421
Usgaonkar, R. N. .. 61

VAIDYA, P. B. .. 377
Vaidyanathan, K. .. 233
Vaidyanadhan, R. .. 282
Varghese, T. M. .. 240
Varma, M. K. .. 470
Varma, N. L. .. 107
Varma, S. N. .. 111
Vasant Rao, .. 18, 141, 214
Vashisht, V. N. .. 182
Vasu, K. I. .. 97
Vasudeva, S. .. 445
Vasudeva Murthy, A. R. .. 322, 359
Vazirani, T. G. .. 564
Veerabasappa Gowda, T. .. 7
Vegad, J. L. .. 326
Venkata Chalapathi, V. .. 367
Venkata Ramiah, K. .. 276, 367
Venkataraman, G. S. .. 542
Venkataramani, K. S. .. 29
Venkatasubramanian, N. .. 233, 254, 394
Venkateswara Rao, P. .. 558
Venkateswara Rao, V. .. 393
Venkateswarlu, P. .. 209
Venugopala Rao, K. .. 210
Verghese, J. .. 63, 281
Verma, C. L. .. 241, 442
Verma, J. P. .. 20, 216, 330
Verma, S. D. .. 278
Vidyanidhi, V. .. 204

PAGE

Vidhyasekaran, P. 308
Vig, O. P. 279
Vijay Kumar, R. 259
Vimala Devi, (Mrs.) R. 374
Viswanadham, Y. 59
Viswanath, R. P. 407, 559
Viswanathan, B. 109, 407, 559
Viswanathan, R. 171
Viswanathan, S. 36
Visweswar, T. 558
Visweswara Rao, V. 159
Vittal, B. P. R. 519
Vyas, M. K. 4

PAGE

WAGLE, D. S. 269
Wahi, R. P. 335
Wassel, G. 497
Wokes, F. 195

YADAV, B. S. 470
Yadava, V. S. 181
Yamdagni, R. 34
Yeddanapalli, L. M. 232, 216
Younis, M. E. 222, 341
Yusuf Kamal, M. 538

Subject Index

PAGE

Abnormal Conjugations in *Spirogyra* .. 444
Absorption Spectrum of MgI Molecule .. 34
Acartia plumosa, Occurrence and Seasonal Distribution of—A New Record for the West Coast of India 115
Accessibility of Substrates to Enzymes in Strawberry Leaves fed with Iodoacetate 222
Acetylcholine—Atropine Antagonism as Determined by a Series of pA Values 29, 73
2-Acetyl-1-naphthol, Occurrence of, in the Stem-bark of *Rhododendron grande* 209
Acrodictys, A New Type from India .. 117
Adrenalin Administration, Effect of, on the Chromatophores of Prawn .. 439
Adsorption of Hydrogen on Nickel-Alumina Catalyst, Effect of Reduction on 232
Aedes vittatus, Establishment of a Diploid Cell Line from Larval Tissues of .. 388
Aedes W-Albus, Karyotype of 537
Aflatoxins, Role of, on Groundnut Seed Spoilage 308
Age of the Tipam Sandstones 436
Aluminium-Germanium Alloy, Impact of Quenching from Melt on Equiatomic 123
Aluminium Monoiodide Band System, Rotational Analysis of 344
Aluminium-Zinc Alloys, Effect of Microaddition of Magnesium on Side-Band Formation 335
Amino-Acids, A Technique for the Separation of Overlapping 303
Amino-Acid Contents of Hypertrophied Organs in Mustard, Qualitative Changes due to *Albugo candida* 240
—s, (Free), of the Haemolymph of *Eyprepocnemis alacris alacris* .. 507
Aminopropionamidoximes, 2-Substituted, and Their Derivatives 464
Amperometric Determination of Uranium as Tellurite 181
Announcements 72, 169, 243, 290, 334, 382, 475, 524, 569
Antagonistic Action of Boron on Copper in Groundnut Plant 44
Anthocyanins in Some Arid Zone Plants, Paper-chromatographic Studies of .. 401
Antibiotics, Discovery and Duplication of, A Correlation 511
Antibiotic Property of a Marine Interstitial Bacterium 327
Antiestrogenicity of Norgestrel .. 467
Aphidophagous Syrphid Fly *Syrphus latifasciatus*, Occurrence of, in South India 66
"Archaean", On the Use of the Term, in Precambrian Stratigraphy 525
Artemia salina, Occurrence of, in Southern India 14
Ascorbic Acid Content in *Pisum sativum* L. Varieties, Salt Tolerance and 69
Atmospheric Oscillations of 4–5-Day Period 386
Axillary Buds, Occurrence of, in an Intergeneric Hybrid between *Saccharum officinarum* and *Sclerostachya fusca* .. 497

Bacopa floribunda, A Little Known Flowering Plant in the Indian Flora 201
Bacterial Blight of Cotton (*Xanthomonas malvacearum*), Races of 20
Balantidium rotundum, Occurrence of, in *Rana tigrina* 352
Banana, Cigar-End Disease of, in India 498
— Fruits, Artificial Ripening of .. 552
Barley, A New Mutant Induced in .. 494
Bat (Vespertilionid), A Rare Case of Monozygotic Synchorial Twins in the 309
—s (Indian), Extrovert Corpus Luteum in Two Species of 436
—s, Degeneration of the Inseminated Spermatozoa After Ovulation in Two Species 489
Beetles *Alphetobius piceus* and *Tribolium castaneum* on *Argas persicus*, Predatory Habit of 419
Bengal Gram, A Bruchid Resistant Strain of 189
Benzhydrols-α-D, Preparation of Some .. 65
Betel Leaves (Piper), Chemical Study of 372
Biosynthesis of Plant Sterols—The Mechanism of the Alkylation of α-Spinasterol at C-24 466
Black Arm of Cotton, Eradication of Seed Infection of 330
Blood-Cell Counts (Differential), in Three Species of Major Carps .. 86
Books Received 24, 48, 72, 96, 119, 144. 169, 194, 218, 244, 267, 290, 312, 358, 382, 404, 426, 449, 475, 500, 524, 546, 569

PAGE

- Boron-10, The Disputed 2·86 MeV Level of 273
- Boron Effect on Starch and Protein Contents of Wheat Grains 235
- Boron, Role of, in Nucleic Acid Metabolism of Germinating Wheat Seedlings 55
- Boseimycin Effect of pH on Its Antimicrobial Activity .. 183
- *Botryosporium* Corda, A New Species of the Genus .. 90
- *Bougainvillea*, Propagation of, by Stem Cuttings 472
- Brachygnathia in Sheep and Its Inheritance 187
- Brevimycins, A New Group of Antibiotic Substances from a *Brevibacterium* sp. Isolate 434
- Bruchid-Resistant Strain of Bengal Gram 189
- Bryozoans of the Shelf Sediments off Visakhapatnam 529
- *Buxbaumia*, Genus in India 14

- CAECAL Outgrowths in the Alimentary Canal of a Centipede *Ethmostigmus spinosus* Newport .. 564
- Calcium Bromide Molecule, The Visible Emission Spectrum of 485
- CaF Molecule, A Note on the Green Bands of 300
- Callus Tissue of Lemon Fruit Vesicle Cultivated *in vitro* .. 513
- *Canna* L. Silicified Pseudostem of, from Early Eocene if Deccan Beds 442
- *Capnodiastrum stylosporum*, A New Record to India . 286
- Capparapidiol, A Synthesis of . 279
- *Capparis grandis*, Tapetal Degeneration in 377
- Cartilage in Eyelid, Unusual Finding of 213
- Caryophyllene Epoxide from the Oil of *Artemesia scoparia* 182
- Catalyst, Changes in the Structure of, During a Catalytic Reaction 316
- Cation Exchange Capacity of Specific Gravity Separates of Sands and Silts of Basaltic Regur Soils . 211
- Cell Biology Conference—III: University of Delhi 81
- *Centrosema virginianum* (Linn.) Benth in India 353
- *Ceratosporium*, New from India .. 141
- *Cercospora*, Causing Leaf-Blight of *Marsilea quadrifoliata*, A New Species .. 304
- Changes in the Structure of a Catalyst During a Catalytic Reaction—Dehydrogenation of Cyclohexanol on Nickel Oxide 316

PAGE

- Charge Transfer Complex of Aromatic Azones with Iodine 107
- Charnockite Peninsular Gneiss Relationship in Mysore State 383
- Chemical Constituents of the Oil from the Fruit of *Semecarpus anacardium* .. 207
  - Examination of *Cyrtanthes mackenii* and *Co-operanthes* Hybrid .. 134
  - Investigation of *Rhododendron ponticum* Hook. 110
- Chemisorption Kinetics, Effect of Temperature and Pressure on 558
- Chemistry of Shelf Sediments on the West Coast of India 171
- Chloride Ions, Effect of, on Germ Tube Growth of *Botrytis* spp. 307
- Chlorophyll, Protein and RNA Synthesis in Cucumber Cotyledons, Complementary Action of KCl and BAP on .. 534
- Cholesterol Mobilising Activity of Testosterone Propionate 4
- Chromosome Number in Silkworm *Antheraea roylei* Moore 423
- Cigar-End Disease of Banana in India 498
- Cladoceran Swarm in Relation to Mackerel Fishery along the West Coast of India 481
- *Cladosporium*, A New Species of, from the Sand Dunes of Western Rajasthan 422
- Classification of Cultivated Varieties of Groundnut 259
- Coffee, The New Malady of, in South India 121
- Colonization by a Wild Potato Species in the Old World (Simla Hills, India) 362
- Colour Change of the Flowers of *Hibiscus mutabilis* .. 323
- "Common Subsidiaries" of Stomata in the Angiosperms, Origin of .. 363
- Complementary Action of Potassium and Benzylaminopurine on Growth, etc. .. 534
- Complexes of Uranyl Ion with Some Amino and Mercapto Acids 302
- Compressible Laminar Boundary Layer Equations for Axisymmetric Body, Similar Solutions of .. . 126
- Computer Science and Technology .. 28
- *Conchoderma virgatum*, Occurrence of, on *Lernaeenicus hemirhamphi* .. 545
- Conglutinating Complement Absorption Test for Identification of Arboviruses 469
- Conidial Types in *Drechslera*, Interpretation of 2
- Copper Electrodeposits, Morphology of 483

PAGE

Corundophilite from a Pelitic Schist near Sydapuram, Nellore District 561
Corynespora cassicola, New Hosts of .. 495
Cosmarium, A Note on an Abnormal .. 215
Cosmological Model with Stress, A New Type of Anisotropil 180
Crassulacean Acid Metabolism in *Euphorbia caducifolia* Haines and Its Diversity 116
Crystalline Matter in Urinary Calculi, on the Deposition of 435
Crystal Structure of Dichloromalonamide 560
— — — Homophthalic Acid, $C_9H_8O_4$ .. 367
— — — Mesaconic Acid, $C_5H_6O_4$ .. 346
— — — Rubidium Salt of Homophthalic Acid 152
— — — Some Addition Compounds of Glycine 147
Cyclohexanol, Dehydrogenation of, on Nickel Oxide 316
Cycloheximide, Effect of, on Nucleic Acid and Protein Synthesis in *Sphacelia sorghi* 165
Cyrtanthes mackenii and *Co-operanthes*, Chemical Examination of 134
Cytological Investigations in *Rosa leschenaultiana* 285
— Studies in Amaranthaceae .. 445
Cytology of the Hybrid *Solanum indicum* × *S. melongena* var. *insanum* .. 22

Dew Point Temperatures Over the World and Their Importance to Indian Shipping 291
Decomposition of Isopropyl Alcohol on $ZnO-Al_2O_3$ Catalyst 109
Diadegma varuna Gupta (Hymenoptera : Ichneumonidae), A Parasite of *Plutella xylostella* 375
6 : 8 Dichloro-S-Substituted 2-Thio-3-Aryl 4-Quinozolones 234
Dichloromalonamide, Crystal Structure of 560
Dielectric Properties of Solutions of Certain Nitrates in Ethyl Alcohol .. 253
Dientamoeba dobelli N. sp. from a Larva of Dung Beetle 112
Differential Blood-Cell Counts in Three Species of Major Carps 86
— Interaction of Marine Humic and Fulvic Acids with Alkaline Earth and Rare Earth Elements 429
— Differential Thermal Analysis Study of Some Carbonate Rocks of the Krol Series 156

PAGE

Dilepidid Cysticercoid from *Uromastix hardwickii* and Its Development in Pup 137
Dislocation Loops in Gadolinium, on the Formation of 461
Dispersion Relation for Transverse Waves in Relativistic Plasma 107
Domains in Ferroelectric Potassium Niobate Single Crystals 368
Down-Coming Long-Wave Radiation over India, Estimation of 59
Dwarfing and Harvest Index in Bread Wheat, Sensitivity of Gibberellic Acid in Relation to 319

Effect of Chloride Ions on Germ Tube Growth of *Botrytis* spp. 307
Elastic Wave Velocities in Certain Araldites, Thickness Dependence of .. 557
Electrical Properties of Thin Silver Films 301
Electron Microscopy and Ultrastructure 28
Elongoparorchis pneumatis, Seasonal Occurrence of, in the Air-Bladder of Cat Fish 562
Elovich Equation, A New Approach to .. 407
Embryology of *Rauvolfia serpentina* and *Catharanthus roseus* 376
Embryonal Haustorium of *Cycas circinalis* 239
Embryonic Cells from an Indian Triatomine Bug, *Triatoma rubrofasciatus*, *in vitro* Culture of 488
Emission Spectrum of the CaBr Molecule 485
Enantiomorphism in Hydrogen Peroxide, the Simplest Dissymmetric Molecule .. 130
Endosperm of *Taxillus vestitus* : A System to Study the Effect of Cytokinins *in vitro* in Shoot Bud Formation .. 177
Environmental Modification of Sex Expression in Sugarcane 521
Epicotyl Grafting in Mango 142
Erythromycin-like Antibiotic Produced by *Streptomyces griseoplanus* .. 91
Ethrel for Breaking Dormancy of Strawberry Seeds 271
Ethyl Methane Sulphonate Treatments Administered Under Pressure .. 274
Exchange Figures in Mitosis 68
Experimental Development of the Oesophageal Worm of Cattle in Rabbit .. 237
Extrovert Corpus Luteum in Two Species of Indian Bats 436
Eyestalk Removal, Effect of, on the Oxygen Consumption Rate in *Caridina rajadhari* 257

PAGE

FLAVONOIDS and Biflavonoids, Some New Pharmacological Properties of .. 533
Floral Colours of the Pelargoniums .. 1
— —, The Red Oleander and the Purple Petrea 25
Fluorescein, Effect of Concentration on Fluorescence Spectrum 412
Fluorescence Spectrum of *p*-Difluro-benzene Molecule 344
Force Constants, Mean Amplitudes of Vibration and Shrinkages of $TaCl_6$ Ion 229
Fossil Axis (Nymphaeceae) from the Deccan Intertrappean Series of Mohgaon-Kalan, India 241
Fracture Traces and Drainage Lines .. 282
Franck-Condon Factors and *r*-Centroids for the *b*-*x* System of SO Molecule .. 345
Fruit-Cracking in Pear, Control of .. 446
Fruiting Plants from *in vitro* Grown Leaf Tissue of *Rauvolfia serpentina* .. 128
Fungal Activity in the Soil below the Root-Tip Region 493
— Remains from Bengal Peat 236

GAMMA-RAY Irradiation, Effect of, on Protein and Amino-Acid Content of Maize Leaves 163
Genetics of Veinal Necrosis in Potato .. 94
Germanium Monobromide, GeBr, A New Band System in the Visible Region .. 10
— Monoiodide, The Band Spectrum of .. 132
Germination of Teliospores of *Puccinia heterospora* 285
Germ Tube Growth of *Botrytis* spp. .. 307
Gibberellic Acid and Indole Acetic Acid Interaction Between 341
Glucosid (A New) from *Cleistanthus collinus* 395
Glycine, Crystal Structures of Some Addition Compounds of 147
Glyphium tillandsiae—A New Genus Record to India 332
Gnathostoma spinigerum, The Development of 199
Golgi Apparatus in Tissue Culture Cells, Demonstration of 487
Green Bands of the CaF Molecule .. 300
Groundnut, Classification of Cultivated Varieties of 259
Growth Substance Content in Tomato Seeds 443

PAGE

HAEMOCYTES of a Centipede *Ethmostigmus spinosus* 324
Haemonchus contortus, from an Indian Elephant in Mysore 356
Halacarus anomalus, the Salt-Water Mite, in the Interstitial Sands on Indian Coast 505
Haplobasidion (A New) from Hyderabad 18
Haplorchiasis taichui in Pariah Dogs .. 13
Heavy Atom Effect in Boric Acid Glass Fluorescein (BF) Phosphor 510
Helicosporous Hyphomycete (A New) from India 214
Heliothis armigera, Parasites Attacking, in Himachal Pradesh, India .. 167
Hemidactylus flaviviridis, A Paratenic Host of *Rictularia cahirensis* .. 535
Hetereleotris zonatus in Indian Waters, Occurrence of 159
Heterophyid Metacercariae Infesting Some of the Freshwater Fishes .. 325
Heterosis in Green Gram (*Phaseolus aureus*) 190
High Temperature K-Felspar in a Basic Charnockite 226
Hillstreams, Morphology of 10
Hilsa ilisha, Hatching of Fertilized Eggs of, in Confined Freshwaters .. 538
Histochemical Staining of Neuronal Lipofuscin by Silver Impregnation .. 113
Histology of Accessory Glands of *Necroscia sparaxes* Westwood (Phasmida) 15
Holographic Method, Measurement of Angular Displacement by Using Speckle Pattern 393
Humic and Fulvic Acids (Marine) Differential Interaction of, with Alkaline Earth and Rare Earth Elements .. 429
Hydrogen Bonding in Complexes of Methanol and Parachlorophenol .. 276
Hydroxytriazenes, Studies in 62

IDREILLA, A New Species of the Genus 519
Immunological Studies on Embryonic Chick Cartilage 518
Immunoserology in Plant Pathology .. 27
Indian Academy of Sciences, Thirty-Fifth Annual Meeting 26
— — — —, Abstracts of Papers .. 27
— — — —, Thirty-Sixth Annual Meeting 427
Inheritance of Betacarotene Content in *Sorghum* 544
— — Clusters per Node in *Phaseolus aureus* Roxb. 265

PAGE

Inseminated Spermatozoa, Degeneration of, in Two Species of Indian Bats .. 489
Interstitial Fauna in Intertidal Sands of Some Andaman and Nicobar Group of Islands 251
— — — the Marine Sands on Indian Coast 504
Irradiation-Induced Aneuploidy and Architectural Alterations of Chromosomes in *Coriandrum sativus* .. 42
Isotope Effect in Bromine in Presence of Sravenger 33

JUTE Seeds, Viability Tests on .. 378

K ABSORPTION Edge of Gallium in GaSb, GaAs, and Gap 391
Karyotype of *Aedes W-Albus* 537
Kinetics of the Addition of Bromine to Olefinic Compounds—Part II .. 36
— — — Oxidation of Mandelic Acid by Iodosobenzene Diacetate 233
— — — — — — — — — — — Lead Tetraacetate 394
— — — — *p*-Methoxyacetophenone by Mn (III) Sulphate 369

Laccoporus nigritulus (Gschwendtner) Comb. Nov. Coleoptera : Dysticidae .. 563
Lactic Dehydrogenase Isozyme in Avian Leukosis 212
Lathyrus sativus, Development of Low Neurotoxin Lines in 518
Lead Fluorapatite, $Pb_{10}(PO_4)_6F_2$ .. 132
Leaf Protein Concentrates, Evaluation of, for Some Essential Amino-Acids .. 269
Leaf-Spot Diseases of Brinjal, Two New 541
Leonhardite from a Granitic Pegmatite in Nellore District 417
Lepidium ruderale Linn. (Brassicaceae) in India 288
Lichens from Kashmir, India .. 441
Linseed, Indo-Gangetic and Peninsular Types, Mutational Evidences for the Origin of 492
Liquid Metal Power Conversion System, Possible Method of 321
Lithium Sulphate-Thiourea-Water System at 30° C. 84
Liver Nucleic Acid, Proteins and Lipids of the Rat, Effects of Enovid on .. 158
Longitudinal Wave Velocities in Rocks, Effect of Water Saturation on .. 515

PAGE

MAGNETIC and Infrared Studies on Dithiocyanato - o - Phenanthroline-Vanadium (IV) Complex 371
— Behaviour of Basalts Containing Very Fine Single Domain Grains .. 313
Magnetization of Metanorite Dyke in Hirapur, Dhanbad 360
Male Meiosis in *Artemisia pallens* Wall 565
Manganese in the Bottom Sediments of the Eastern Part of Bay of Bengal .. 225
Mangifera indica, Resistance of, to Scale Insects Infestation Due to Flavonoids 497
Mean Square Amplitudes in Dimethylformamide and Dimethylacetamide .. 367
Meloidogyne incognita, Prevalence of, in Various Plants of Rajasthan .. 470
2 - Methyl - 3 - (3 5 - Dimethyl - 4 - Hydroxyphenyl) - 3, 4 - Dihydroquinazoline-4-One and Its Derivatives .. 253
Methyl Ethers of Limonene 63
Metopirone, Effect of, on Pregnancy in Albino Rats 184
Mesolite from Poona 65
MgBr Molecule, The Electronic Emission Spectrum of 509
MgI Molecule, Absorption Spectrum of 34
Microclinization of Plagioclase by Solid-State Reaction 359
Microfossils from Parasia Coalfield, Chhindwara, Dist., M.P., India .. 88
Micronutrients in Nitrogenous, Phosphatic and Mixed Fertilizers .. 145
Miliolid Foraminifer from N-E Part of the Arabian Sea 87
Mineralogy of Achroite from a Pegmatite near Ajmer 154
Mixed Ligand Complexes of *Bis*-Acetylacetonato Manganese (II) with Nitrogen Donor Ligands 60
Molecular Constants of Tungsten Hexachloride Molecule 58
Molybdenum (V)—Kojic Acid Complex, Studies on 210
Monazite and Zircon Sands, Effect of Acid Leaching on Alpha-index of .. 229
Morphology of Copper Electrodeposits from Acid Copper Sulphate Bath .. 483
Mushroom Extract, Use of, in Culture of *Rhizobium* 400
Mutational Evidence for the Origin of Indo-Gangetic and Peninsular Types of Indian Linseed 492
Mystus vittatus, Radioiodine-Induced Thyroid Tumours in 350

PAGE

NATURAL Intermediaries and Paratenic Hosts of *Simondsia paradoxa* .. 536
Neptunium-239 from Fallout Samples, Determination of 49
Nickel, Distribution of in the Marine Sediments Off the West Coast of India 30
Nicotiana amplexicaulis, A Note on the Cytogenetic Status of 410
Nitrification-Mineralization of Urea as Affected by Retarders 'N-Serve' and 'AM' 211
Nocardia, Method for Rapid Identification of 135
Nodulation of Soybean in Coimbatore Soil 491
— under Unfavourable Soil Conditions .. 93
Non-Equilibrium Solidification in a Peritectic System 477
Nucleic Acids in the Dissolved Constituents of Sea-Water 501
Nutrition Seminar 195

OESOPHAGEAL Worm of Cattle, Experimental Development of, in Rabbit .. 237
O-H....S Bonds in $Na_2S_2O_3$, 5 H_2O .. 181
Oil-Bodies in Indian Liverworts .. 458
Oil-Palm (*Elaeis guineensis*), A Natural Host of Root (Wilt) Disease Pathogen of Coconut 260
Oleander, The Red and The Purple Petrea, Colours of 25
Ontogeny of Stomata in *Trachyspermum ammi* 19
Osmophilic Yeast *Torulopsis etchellisii*, Occurrence of, in India 566
Ostracods, Two Interstitial, on the Occurrence of, on Indian Coast 504
Oudemansia subcoerulea—The First Record of a Marine Collembola from India 490
Oxidation of Hydrazine Sulphate by Thallium (III) in Aqueous Sulphuric Acid 254
Oxide/Metal Interfacial Energy, Estimation of, by Internal Oxidation .. 548
Oxidimetric Determination of Phloroglucinol 462
— — — Thallium (I) 370

PALAEOBATHYMETRY of the Reef Carbonates at the Base of Trichinopoly Upper Cretaceous 373
Palaeocurrents in the Central Part of the Vindhyan Basin 339
Particles in Einstein Universe 82

PAGE

Paraoxon, Effect of, on the Somatosensory Evoked Potentials in the Rat 466
Peat-Based Legume Inoculant Experiments with Soybean 328
Pelargoniums, Floral Colours of .. 1
Periconia, A New Species of, from Varanasi, India 43
Perithecial Stage of *Pestalotia osyridis* .. 16
Permeability to Water of Soils Rendered Impermeable by Sodium Carbonate 454
Pest Resistance in an *Indica* Rice Variety TKM 6 162
Petrea, The Purple, The Red Oleander and Colours of 25
Phase Studies in the System $FeNb_2O_6$-$YNbTiO_6$ 396
Phase Studies in the System YTa TiO_6-$NdTaTiO_6$ 36
Phenylhydrazine and 'GCAh' Administration in Rats, Changes in Adenosine Phosphate Content in Liver .. 281
Phloroglucinol, Oxidimetric Determination of 462
Phosphobacteria in Marine Environment, Occurrence and Distribution of .. 398
Photo-Induction, Effect of, on the Critical Photoperiod of *Chenopodium album* 138
Photoperiodism, Effect of, on Moulting in *Hemigrapsus nudus* 149
Phyllosticta Pers. ex Desm., A New Species from Jodhpur 378
Physaloptera Nematode Parasite, Partial Life-Cycle of, in Stomach of Carnivores 399
Pila-lateralis, on the Presence of, in *Tilapia mossambica* 11
Pineapple, Induction of Flowering in, Effect of Ethrel, NAA and NAD .. 530
Plagioclase Tecoblasts in Dolerite Dykes of Pachmarhi Area, M.P. 516
Planktonic Foraminifera from the Laki of Rajasthan, India 355
Plastic Deformation of Polycrystalline Magnesium, Rate-Controlling Dislocation Mechanism 97
Plasmodesmata in the Hairs of *Leptadenia reticulata* 331
Platinum Ware in Thermography, Use of 206
Plutella xylistella Parasite *Diagegma varuna* 375
Pollen Grains of *Urena lobata* Linn. .. 264
Polycrystalline Magnesium, Plastic Flow in, Rate-Controlling Dislocation Mechanism for **97**

PAGE

Polyhedrosis, Effect of, on the Haemolymph Transaminases in the Silkworm *Bombyx mori* 7
Polymerization of Aqueous Acrylic Acid Photo-initiated by Mono- and Di-Azido Cobalt (III) Amines 532
Polypeptalous Flowers in Snapdragon in Response to Added Morphactin .. 354
Polyporus calcuttensis and Its Imperfect Form 258
Pomfrets in the Indian Water, A Record Landing of 186
Pongamol Complexes of Gadolinium, Holmium and Erbium 486
Potassium and Benzylaminopurine, Complementary Action of, on Growth, etc., in Cucumber Cotyledons .. 534
Potato (A Wild Species), Establishment and Colonization by, in Simla Hills .. 362
Potato, Veinal Necrosis in, Genetics of 94
Problems of the Basement in Mysore State 245
Protein-Bound Amino-Acids of Tomato Fruits, Changes in, under Pathogenesis 140
Protein Synthesis in *Ancistrocoma pelseneeri*, Ultrastructural Evidence of 438
Psecdodiaptomus jonesi, A New Calanoid Copepod from Indian Waters .. 78
Pseudolycorine in the Bulbs of *Vallota speciosa* 374
Psidium guajava, Isolation of Trisomics and Tetrasomics in 409
Puccinia heterospora, The Mode of Germination of Teliospores of 285
Pyricularia, A New Species of, on Bajra 287

QUANTITATIVE Separation of Cadmium (Or Lead) from Calcium and Phosphate 277
— Separation of Calcium Phosphate and Silicate 415

RADIOCARBON Dates of Some Quaternary Samples 219
Radioiodine-Induced Thyroid Tumours in the Indian Freshwater Catfish *Mystus vittatus* 350
Radio-Resistant Auxotrophic Strain of *Rhizobium leguminosarum* 542
Rainfall over India and Neighbourhood, Some Salient Features of the Space-Time Variations of 101
Raman and Infrared Spectra of Phenanthrenequinone 405

PAGE

Rauvolfia serpentina and *Catharanthus roseus*, Embryology of 376
Rayleigh's Flow Past an Infinite Porous Plate 204
Reaction of Polythionates with Iodine Monochloride 348
Red Cell Acid Phosphatase Variants on Christian Girls from Kerala .. 516
Reductimetric Determination of Selenite 83
Reduction of Sulphate by Sulphur in Vacuum 322
Reversal of N-Benzyl Orthofluorophenoxy Acetamide-Induced Hypocotyl Inhibition by Gibberellic Acid .. 46
Reviews and Notices of Books 23 47, 70, 95, 118, 143, 168, 193, 217, 242, 266, 289, 311, 333, 357, 380, 402, 424, 448, 473, 499, 523, 546, 568
Rhizobium leguminosarum, Radio-Resistant Auxotrophic Strain of 542
Rhizomastix gryllotalpae N. Sp. from *Gryllotalpa africana* 21
Rhododendron ponticum, Chemical Investigation of 110
Rhynchospora wightiana—A Unisexual Plant 261
Rice, Haploids in, Totipotency of Gametic Cells and the Production of .. 174
River Waters (Indian), Occurrence of Na, K, Rb, Ca and Sr in 105
Rocks, Longitudinal Wave Velocities in, Effect of Water Saturation 515
Root (Wilt) Pathogen in Developing Seed Coconuts, Distribution of .. 188
Root-rot of *Arachis hypogea* Seedlings Caused by *Pythium debaryanum* .. 44
Rotational Analysis of a $^3\Pi_{0,1}$-$X^1\Sigma$ System of AlBr 228
Rust Fungi, Seasonal Distribution of .. 418

Salix tetrasperma, Out of Season Flowering in the Stem Cuttings of 166
Salmonella tshiongwe, Isolation of, from a Guinea-Pig 440
Sannhemp Mosaic Virus, Behaviour of, in Sannhemp and Tobacco 263
Sapium sebiferum, Development of, Female Gametophyte in 17
Schiff's Bases from Isoniazide, on the Reaction of 322
Schizoporella Hincks (Ectoproeta), A New Species of, from the Arabian Sea 238
Scolecobasidium, A New Species of .. 305

PAGE

Seasonal Distribution of Rust Fungi .. 418
— March of Surface Pressure Gradients Across India and the South-West Monsoon 248
— Variation of the Delays Between Spread F and Magnetic Activity .. 413
Secretory Activity of the Cells of the Hepatic Caeca in Some Acridids .. 297
Secretory Idioblasts of the Foliar Epidermis of *Crotalaria retusa* .. 262
Sediment Movement by Fluorescent Tracers, Study of, at Haldia Anchorage 451
Seed Mucilage of *Ocimum canum* .. 39
Selenite, Reductimetric Determination of 83
Semecarpus anacardium, Chemical Constituents of the Oil from the Fruits of 207
Semi-Sterility in Gram 498
Sensitivity to Gibberellic Acid in Relation to Dwarfing and Harvest Index in Bread Wheat 319
Serodiagnostic Method for Detecting Mosaic-Infested Cassava Plants in Field 191
Shelf Sediments on the West Coast of India, Chemistry of 171
Silicified Pseudostem of *Canna* L. from Early Eocene of Deccan Intertrappean Beds 442
Siphonosoma australe, on the Occurrence of at the Visakhapatnam Harbour .. 12
Sodium, Potassium, Rubidium, Calcium and Strontium Contents in Indian Rivers 105
Soil Perfusion Technique for the Isolation of Triacetin Splitting Microbial Culture 38
—s (Kerala), The Chemical Nature of Organic Complexes in 353
Solubility Limit of $La_{0,5}Li_{0,5}$, TiO_3 in $BaTiO_3$ 348
Sorghum, Inheritance of Betacarotene Content in 544
Southern Sannhemp Mosaic Virus, Purification of, Using Butanol and Differential Centrifugation 539
Spectrum of FeCl in the Red 392
Spherically Symmetric Space-Times, Suspected Converse of a Theorem .. 460
Spiranes, Disubstituted, Synthesis and Rearrangement of 512
Squashing Stipule Tips of Pea, A Technique of 494
Stem Rust of Wheat (*Puccinia graminis*), **New Factor for Resistance to** .. 19

PAGE

Stereo Numbers in Sugar Chemistry, Part II—Aldehexopyranoses .. 85
Sterilizing Effect of a Dietary Surplus of Biotin in *Trogoderma granarium* Everts 551
Strawberry Seeds, Ethrel for Breaking Dormancy of 271
— Leaves, Fed with Iodoacetate .. 222
Sugarcane, Environmental Modification of Sex Expression in 521
Sulphur Monohalides, Force Field and Mean Square Amplitudes of Vibration of 204
Supernumerary Chromosomes in the Genus *Apluda* 330
— Surface Layers in Radiated Amoebae 468
Suspected Converse of a Theorem Regarding Spherically Symmetric Space-Times 460
dl-Sylvestrene 281
Synthesis of Di-α-Naphthyloxymethane 347
— — 4, 6-Dimethylxanthyletin .. 61
— — Hydrindene Derivatives 280
— — Some Hydrazones 278
— — 3 - Methoxy - 7 - Amino Flavones as Potential Bactericides 133
— — 4-(2′-Thienyl)-and 4-(2′Furyl)-Thiazoles 417
— — 4, 5′, 8-Trimethylphoralene .. 349
— and Rearrangement of Disubstituted Spiranes 512

TAPETAL Degeneration in *Capparis grandis* 377
Tea, Clonal Selection and Propagation .. 29
Technique for the Separation of Overlapping Amino-Acids 303
Tetracyclic Tripterpenes (New) from *Fomes senex*: Senexonol, Senexdione 416
Thelytokous Hybrid, The Production of, in an Interspecific Cross Between Two Species of *Trichogramma* .. 76
Thermal Decarboxylation of Substituted Chlorobenzoic Acids 463
— Decomposition of Cadmium Chromate 230
— Degradation of Butyl Rubber in Chlorobenzene, Order of Reaction for 83
Thiazolothiohydantoin Derivatives, Synthesis of 559
Tissue Cultures of *Trigonella foenum-graecum,* A Simple Squash Technique for 40
Titanum Monoiodide, Band Spectrum of 153

PAGE

Tomato Seeds, Growth Substances Content in 443
Tongue Pigmentation in Man: A New Genetic Trait 161
Torulopsis etchellsii, Occurrence of the Osmophilic Yeast, in India 566
Totiopotency of Gametic Cells and the Production of Haploids in Rice .. 174
Tracheal Pulsation in a Marine Centipede *Mixophilus indicus* 397
Transaminase Activity in Silk-Worm *Bombyx mori*, Effect of Polyhedrosis on 7
Tremogasterina Canu (Ectroprocta) Three Species of the Genus, from the Indian Ocean 135
Tribonema Genus in India 522
Triloculina echinata, A Little Known Miliolid Foraminifer from Arabian Sea 87
Triops longicaudatus, Occurrence of the Tadpole Shrimp, in Southern India .. 352
Trisomics and Tetrasomics in Guava, Isolation of 409
Twin Investigation in Leprosy in West Bengal 283

ULTRASONIC Relaxation in Phenyl Salicylate 556
— Velocity in α-Picolina-Water Mixture 299
Ultrastructural Evidence of Heavy Protein Synthesis in *Ancistrocoma pelseneeri* 438
Urinary Calculi, on the Deposition of Crystalline Matter in 435

PAGE

VASCULAR Permeability in the Sheep, Effect of Lactic Acid and Kallikrein on 326
Vibrational Spectra of Deuterated Aniline 435
Vibrio cholerae Biotype *ElTor*, *in vitro* Sensitivity of, to Clioquinol .. 111
Vinyl Polymerisation Initiated by Redox Systems Based on Trivalent Manganese 37
Vitamin A in the Median Eyes of the Scorpion, *Heterometrus fulvipes* .. 120
Vitellogenesis in Some Gall Midges .. 256

Wak goldmanni (Bleeker), A New Record from Indian Waters 67
Whole Wheat Meal Dough, Studies on Darkening of 421
Wolff-Kishner Reduction of α-Hydroxy Ketones 372

X-RAY Crystallographic Data on Veratrilphthalide, $C_{17}H_{14}O_4$ 131
— Patterns of Mollusc Shells from Indian Waters 51
Xanthates and Dithiocarbamates, Determination of, with Potassium Iodate .. 209
Xanthomonas malvacearum, A Bacteriophage Against 216
— *oryzae*, Effect of Mixture of Inoculations of Virulent and Less Virulent Isolates of 420

YEAST, Occurrence of *Torulopsis etchellsii*, in India 566

THE PELARGONIUMS

Sir C. V. RAMAN

Abstract

The spectra exhibited *in vivo* by pelargoniums of various colours, as also the absorption spectra of their acetone extracts have been studied. The colouring material is the same in all cases, but it is present in widely different quantities.

BRILLIANTLY coloured flowers appearing in clusters at the end of terminal stalks, and there may be a dozen or more such clusters carried by one plant, make the pelargonium a great favourite with gardeners. The individual plant being itself of no great height or spread, it can be conveniently grown in pots of modest size. Pelargoniums are to be found in extensive use as window-box plants for town houses in the cooler climates of the world. These plants (which are commonly called geraniums) do not thrive well in the hot plains of India, but the climate of Bangalore appears to suit them excellently. A hundred pots disposed at regular intervals along the boundary of a garden and kept in condition make a magnificent display of colour. The pots should be raised above the ground by placing them on [illegible] to prevent entry of larvae coming up from the earth.

There are several distinct species of pelargonium which may be readily distinguished from each other by the shape and feel of their leaves. *Pelargonium inquinans* has leaves which are almost circular, soft to the touch and have undulating edges. *Pelargonium peltatum*, also known as ivy leaved geranium, has trailing slender stems, and possesses thick, dark green leaves. The pelargoniums seen at Bangalore fall into five colour groups. The ivy leaved plants bear flowers which are a rich red, approaching crimson. The soft leaved species usually exhibit flowers of a brilliant scarlet colour. There are also plants bearing numerous clusters of flowers which are a bright rose-pink and others with flowers of an orange hue. Some plants are also to be seen with flowers which are basically white but have red margins. The delightful scent of the leaves of some geraniums also deserves mention.

Viewing a cluster of the flowers held in sunlight through a pocket spectroscope reveals the progressive change in the character of the spectrum as we pass from the case of the red flowers to the scarlet and then to the orange. With the red flowers, there is a practically complete extinction of all wavelengths less than 600 mμ in the light which emerges from the petals after internal absorption and diffusion. The limit shifts to 580 mμ in the case of the scarlet flowers and to 550 mμ for those which are orange. On the other hand, the flowers which are a bright rose-pink in colour do not exhibit a complete extinction of any part of the spectrum. There is a marked weakening of the spectrum in the wavelength range from 500 mμ to 600 mμ which includes the green and yellow sector, but there is no observable absorption in the region of wavelengths greater than 600 mμ. Wavelengths less than 500 mμ, in other words, the blue region of the spectrum, remain visible though with appreciably reduced intensity. The situation is thus very similar to that observed with roses of different colours and discussed in a recent issue of *Current Science*.

The red flowers of the ivy leaved pelargonium readily yield up their colour when placed in a glass beaker and shaken up with sufficient acetone to cover the petals. The acetone extract shows at first the same red colour as the flowers themselves. But the colour of the extract fades away rapidly in the course of a few minutes and soon disappears completely. The progressive fall in absorption can be followed with a five-centimetre column of the extract held against a brilliant field of white light and viewed through a spectroscope. The absorption which at first is complete for all wavelengths less than 600 mμ is observed to diminish over the whole range, and especially in the region between 550 mμ and 600 mμ which is normally the brightest part of the spectrum. Wavelengths less than 500 mμ begin to make their appearance and progressively become more intense. Finally, the entire spectrum comes through with no observable weakening.

Acetone extracts may also be obtained with the flowers of other hues and the progressive falling off in colour and absorptive power may similarly be followed. But the effects are much less striking than in the case of the red flowers.

Since, in all cases, the absorption by the flowers of pelargonium appears in the yellow and the green sectors of the spectrum, we are justified in recognising the material responsible for the observed colour as Florachrome B. It is also evident that the colour variations observed are due essentially to the quantity of the pigment present in the petals being substantially different in the different cases.

INTERPRETATION OF CONIDIAL TYPES IN *DRECHSLERA**

C. V. SUBRAMANIAN

University Botany Laboratory, Madras-5

In a study of conidial types in *Cochliobolus sativus* (Ito and Kurib.) Drechsler ex Dastur [= *Drechslera sorokiniana* (Sacc.) Subrm. and Jain], Subramanian and Jain[1] reported production of several kinds of conidia. Apart from the common (non-furcate) conidia, they observed also many furcate conidia. Three types of non-furcate conidia were found, *viz.*, (*a*) porospores, which were typical of the species; (*b*) gangliospores; and (*c*) blastospores. Both mono-ascospore and mono-conidial isolates were included in their study and the authors observed that "though non-furcate porospores were typical of the species, the consistent production of gangliospores by all isolates and of blastospores by two of them was noteworthy". In later work, Jain[2] investigated conidial types in a number of species of *Drechslera* and observed production of gangliospores, besides typical porospores, in several of them such as *D. bicolor* (Mitra) Subram. and Jain, *D. maydis* (Nisikado) Subram. and Jain, *D. cookei* (Sacc.) Subram. and Jain, *D. triticivulgaris* (Nisikado) Ito, and two possibly new species of *Drechslera* (taxonomic species 1 and 2). Luttrell[3] observed both porospores (= his porogenous conidia) and gangliospores (= his murogenous conidia) in *Helminthosporium sorokinianum* Sacc. (= *Drechslera sorokiniana*). He stated that the murogenous pattern of development was common when the fungus was grown at higher temperatures (say 31° C), whereas at lower temperatures (below 25° C) the porogenous method of development prevailed. Both Subramanian and Jain[1] and Jain[2] found production of porospores and gangliospores on the same conidiophore in mono-conidial clones and, therefore, according to them, Luttrell's[3] observation that formation of murogenous conidia (=gangliospores) may be a temperature-response needed further investigation. In a recent intensive study of the effect of temperature on conidial types in several species of *Drechslera*, my colleague Bhat[4] has very clearly shown that the pattern of conidial morphogenesis is, in fact, governed by temperature. Working on several species of *Drechslera* (*D. sorokiniana*, *D. oryzœ* (Breda de Haan) Subram. and Jain, *D. bicolor*, *D. biformis* (Mason and Hughes) Subrm. and Jain, and *D.* tax sp. 2), he found that several isolates of some of these typically produced porospores at 24° C, porospores and some gangliospores at 28° C, and mostly or entirely gangliospores at 34° C.

Both for the student of morphogenesis and for the taxonomist for whom conidial ontogeny has great significance, these findings should be of some interest. The fact that a mono-ascospore or a mono-conidial clone of a taxon produces three different kinds of conidia raises the important problem of whether there could be any basic similarity in the morphogenetic patterns that lead to the production of the porospore, the gangliospore and the blastospore in the fungi which are being discussed in this paper. The fact that three conidial types have been found at once suggests differences, but what are the differences?

That a conidium may be produced through a pore on the conidiophore was first suggested by Hughes[5] and the term "porospore" was proposed by him for such conidia. Although porospores have been reported in several genera, critical studies of the development of the porospore are few. Studies at the ultra-structural level seem absolutely essential for a proper understanding of conidial ontogeny and, although such studies are few, Campbell's[6] thorough and painstaking investigation of *Alternaria brassicicola* (Schw.) Wiltshire leaves little room for doubt that in this fungus spores are formed by the growth of a bud through a fairly well-defined pore, which is apparently produced enzymically, for there is no sign of mechanical rupture". If electron micrographs are a guide, the pore is formed in the outer layer of the wall of the conidiophore, permitting a blowing out of an inner layer of the conidiophore wall which is evidently extensible, and there is naturally no continuity between the wall of the conidium and the outer layer of the conidiophore wall (Fig. 7).

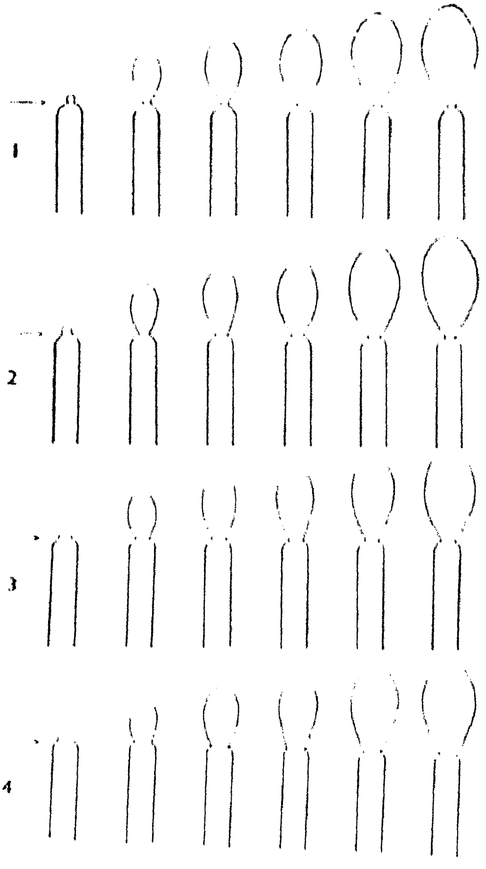
---

* Memoir No. 82 from the Centre for Advanced Studies in Botany, University of Madras.

In the development of a blastospore, no pore is involved, but a narrow zone of the conidiophore wall, which is obviously extensible, blows out. Since the blowing out is restricted to a narrow zone, a conspicuous constriction separates the conidium from the conidiophore; this constriction is also the point of separation of the conidium and conidiophore. The wall of the conidium is continuous with that of the conidiophore. It is pertinent to add here that what Luttrell interpreted as mirogenous conidia developing a constriction at the point of separation between conidium and conidiophore (see his Figs. 31, 32) are, in fact, blastospores (his blastogenous conidia) and not gangliospores (mirogenous conidia).

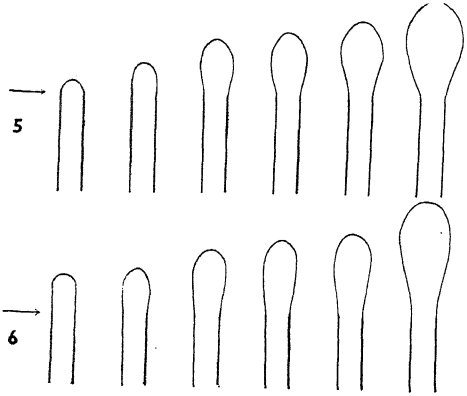
Another type of conidium consistently produced by certain isolates of some species of *Drechslera* under certain conditions is the gangliospore. As defined by Subramanian, a gangliospore is the swollen tip of a hypha transformed into a conidium, and a conidium initial may or may not be delimited. The observations of Jain and of Bhat[4] on the ontogeny of the gangliospore in several species of *Drechslera* show that even in the same species and, indeed, in the same culture, a conidium initial may be delimited early sometimes, but not always. What appears significant is the fact that, irrespective of whether a conidium initial is delimited or not, in the development of a typical gangliospore, the apical part of a hypha swells gradually, a zone of the hyphal wall at least equal in diameter of the hypha itself, and often extending down to an appreciable length, from the tip of this hypha, becoming extensible and swelling gradually to a size and shape characteristic for each species or isolate; the swollen part is transformed into a conidium. In the species we have investigated, conidia formed in this way remain attached to the hyphae on which they are produced, being not easily shed from the hyphae on which they are borne.

Essentially then, blastospores and gangliospores are both products of extensibility and plasticity of the wall of the conidiophore, and this reflects the basic similarity between them. However, the width or area of the wall that is extensible relative to the width of the conidiophore is different in the two cases and these differences are represented in Figs. 1–6. A similar situation would also explain the variations in the width of origin of germ tubes from germinating spores of *Mucor rouxii* (Calmette) Wehmer reported by Bartnicki-Garcia and Nickerson who found that the point of origin of germ tubes was narrow when the fungus was incubated under CO_2, and wide when incubated under air (see also Romano[9]). In quantitative terms, blowing out of an area or zone less than the width of the conidiophore apex would give rise to a blastospore (Figs. 1–4) and in such cases a constriction between conidium and conidiophore is



FIGS. 1–4 illustrate development of blastospores. Figs. 1–4. In that order, form a graded series of increasing width or area of the extensible part of the conidiophore wall. Note the constriction between conidium and conidiophore in all cases.

always present. If one makes a critical study of conidial ontogeny, in most cases it should, therefore, be possible to distinguish a blastospore from a gangliospore on the basis of the constriction between conidium and conidiophore which is present only in the case of the blastospore (Figs. 1-4) but not the gangliospore (Figs. 5-6); but, as stressed by Subramanian,[10] "the line between a blastospore and a gangliospore at maturity may be dubious" sometimes. This is because considerable variation in the width of this constriction can be seen and a graded series can be built up between the two extremes of a blastospore produced by the blowing out of a narrow zone of the conidiophore wall and the gangliospore formed by the swelling of an extensive zone of the conidiophore including its entire apex (Figs. 1-6), and if the width of the conidiophore producing conidia at its tip is relatively narrow, it would be difficult to state precisely to which of these two categories a conidium may be assigned.



FIGS. 5–6 illustrate development of gangliospors: a larger zone of the wall is extensible and gradually swells in the series in Fig. 6 than that in Fig. 5.

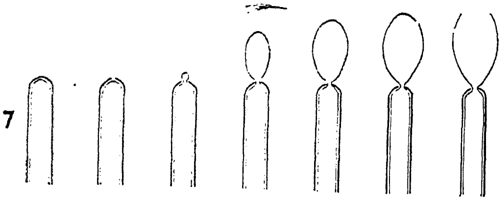


FIG. 7 illustrates the development of porospores in which a pore is formed on the conidiophore and an inner wall or wall-layer blows out through the pore and develops into a conidium. (Area or part of conidiophore wall above arrow extensible.)

The most significant point about the three patterns of development observed in the case of the *Drechslera* spp. investigated is the fact that, in the development of the porospore, the wall of the conidiophore, or its outer layer, according to interpretation, seems to contribute nothing to the wall of the developing conidium and the conidial wall seems to be the blown out of an extensible inner wall or wall-layer; on the other hand, in the development of the blastospore and the gangliospore, the wall as a whole, and not merely an inner layer, becomes extensible permitting the development of a bud in the case of the former and a generalized swelling in the case of the latter. I believe that closer scrutiny of relationship of wall or wall-layers in elucidating conidial ontogeny would contribute considerably to the correct interpretation of conidial types and a better understanding of conidial morphogenesis in imperfect fungi.

1. Subramanian, C. V. and Jain, B. L., *Trans. Br. mycol. Soc.*, 1964, **47**, 613.
2. Jain, B. L., *Doctoral Thesis*, University of Rajasthan, 1968.
3. Luttrell, E. S., *Mycologia*, 1963, **55**, 643.
4. Bhat R., 1969 (Unpublished).
5. Hughes, S. J., *Can. J. Bot.*, 1953, **31**, 577.
6. Campbell, R., *J. gen. Mycrobiol.*, 1969, **54**, 281.
7. Subramanian, C. V., *Curr. Sci.*, 1962, **31**, 409.
8. Bartnicki-Garcia, S. and Nickerson, W. J., *J. Bact.*, 1962, **84**, 829.
9. Romano, A. H. *in* Sussman, A. S. and Ainsworth, G. C. (Eds.), *The Fungi, An Advanced Treatise*, 1966, **2**, 181.
10. Subramanian, C. V., *Mycopath. mycol. appl.*, 1965, **26**, 373.

CHOLESTEROL MOBILISING ACTIVITY OF TESTOSTERONE PROPIONATE

M. K. VYAS*

It is known that adrenaline administration causes a decrease in lipemia associated with elevation in the basic metabolism and a sensible increase in fat of the liver, particularly of the cholesterol esters. The thyroid also participates as an important regulator of the blood cholesterol level. Testosterone was found to mobilise unesterified fatty acids from the body fat stores, as demonstrated by increased level of serum fatty acids in female rats by Laron and Kowadlo.[1] They had injected 10 mg. of testosterone to starved female rats. Norcia and Evans[2] found resemblance between free fatty acids of plasma and of the triglycerides liberated from the adipose tissue. Former workers had concluded that the source of the increased free fatty acids in serum was adipose tissue, thus attributing the lipid-mobilising effect to testosterone.

---

* Present address: V.P. Chest Institute, University of Delhi, Delhi-7.

A similar effect of testosterone propionate is further observed in the present investigation in relation to cholesterol. Excretion studies have shown that after intramuscular injection of testosterone propionate in oil, this hormone is completely eliminated from the body in a very short period.[3] Therefore, to ensure a moderately constant level of activity, the hormone was injected every day for a period of 15 days.

METHODS AND MATERIALS

Adult male albino rats were used in the present investigation. Subcutaneous injection 0·5 mg./100 g. of body weight) of testosterone propionate in arachis oil† was given to each rat daily. Another group of control rats was maintained in similar conditions except for the administration of hormone. Access to food and water was free.

Fifteen days after the commencement of the injection, the rats were sacrificed and blood, liver and small intestine were collected. Serum was used for chemical analysis. Lipids were extracted by the Soxlet extraction method using chloroform : methanol (2 : 1) mixture. This lipid extract was concentrated under vacuum at 37° C. and later subjected to adsorption chromatography using an activated alumina column, as described elsewhere,[4] for the separation of free and esterified cholesterol. The esterified cholesterol fraction was saponified and then extracted with redistilled petroleum ether (60-80° C.). Both these fractions were precipitated with digitonine. The digitonide complex was dissolved in 2 ml. of glacial acetic acid. To this, 4 ml. of a mixture consisting of 5% sulphuric acid in acetic anhydride was added. The colour was developed by keeping the tubes in a closed water-bath at 30° C. for 30 minutes. Optical density was read with the help of "Spectronic 20" (Bausch and Lomb) colorimeter at 630 mμ and was compared with standards treated simultaneously. Different concentrations of cholesterol were also treated earlier and a reference curve passing through the origin was obtained. This was always referred to after obtaining the experimental values.

RESULTS

The initial body weight of the rats in both the groups and the changes observed thereafter are shown in Table I. At the end of two weeks, a negligible difference in the body weight was observed.

TABLE I

Showing the changes in weight of the rats from 0 to 15 days. Each series included eighteen animals. The day before starting the injections is indicated as 0 day.

	Weight in gm. at 0 day	Weight in gm. after 15 days
Control ..	165±12	166±14
Testosterone propionate treated	196±14	200±12

The average values of free and esterified cholesterol in serum, liver and small intestine of rats are shown in Table II. After the injection of testosterone propionate, an increase in the level of free serum cholesterol is observed while the esterified fraction has decreased by 36%. As a result, the ratio, total/esterified (1 : 3) of serum cholesterol in the control rats increases to 3·1 in the injected rats

TABLE II

Showing the value of free and esterified cholesterol of serum, liver and small intestine of eighteen rats taken in each series

		Serum cholesterol mg./ml.		Liver cholesterol mg./gm.		Small intestine cholesterol in mg.	
		Free	Esterified	Free	Esterified	Free	Esterified
Controls	Mean value	0·14	0·42	1·88	0·141	8·87	0·38
	S.D.	0·03	0·11	0·125	0·0618	0·72	0·05
Testosterone propionate-treated	Mean value	0·65	0·31	1·31	0·032	6·2	0·21
	S.D.	0·17	0·12	0·27	0·005	0·3	0·023

---

† Kindly supplied by CIPLA, Bombay.

(Fig. 1). The livers of testosterone propionate-injected animals showed a very marked increase in the ratio of total to esterified cholesterol. It was from 14·3 to 42·0. The ratio of weight of liver to body weight however remained constant in both groups. An increase or a decrease in the free or esterified cholesterol respectively or both would yield such results. In this case, the free fraction fell by 30% and the esterified by 77%.

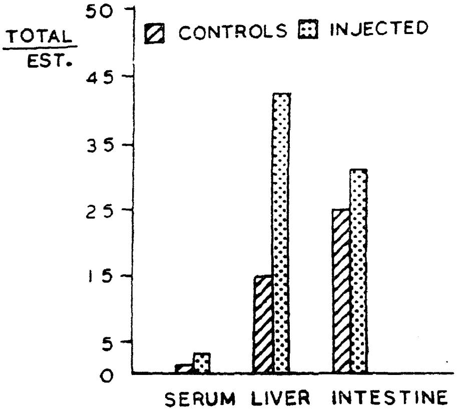


FIG. 1. Showing the value of total/esterified cholesterol values in serum, liver and small intestine.

The total cholesterol of the intestinal wall decreased by 36% while the value of total/esterified ratio has increased slightly. The decrease observed is mainly in the free cholesterol.

DISCUSSION

In a normal adult male rat, the production and metabolism of testosterone is fixed. The exogenous source (5 mg./kg. body weight) administered subcutaneously would normally not metabolise completely through the same pathway but will produce certain effects on responsive tissues of the organism. In general, the metabolic disappearance of a molecule can be observed by three processes functioning in the body: destruction, transformation and incorporation or synthesis. Among these, only the process of transfer gives an idea about the relative distribution of any substance between the organ and the serum. That is the reason that blood cholesterol level is considered as the resultant of its rate of synthesis and of destruction.

Testosterone administration caused a five-fold increase in the free fraction of serum cholesterol indicating an accelerated flow of free cholesterol from hepatic and other tissues into the serum pool. This is in marked contrast with the effect of the thyroid hormones which cause a reverse shift of cholesterol from the blood into the tissues.

The remarkable fall in esterified cholesterol value in the liver could be due to two reasons. One of them is the classical elimination through cholic acid *via* bile. From the increase in serum free cholesterol noted above, it is likely that on administration of testosterone propionate, hepatic cholesterol esters are hydrolysed and then released into serum. This would simultaneously increase the free fatty acids value in serum also.

This androgen caused a fall in intestinal wall cholesterol which is chiefly in the free form.[4] This fall of free cholesterol to about 36% after testosterone propionate could be due to its mobilising action on the cells of the intestinal wall.

The changes in the free and esterified cholesterol fractions of serum, liver and small intestine observed after continuous injections of testosterone propionate demonstrate that along with the decrease in tissue fractions, serum-free cholesterol has increased.

SUMMARY

Significant increase in free cholesterol of serum after continuous injections of testosterone propionate for two weeks, with a corresponding decrease in the values of hepatic and intestinal cholesterol demonstrates the mobilising activity of this androgen in relation to cholesterol. The mobilising effect is from tissues to serum.

I wish to express my thanks to the Dean, T.N. Medical College, Bombay-8, for providing facilities during this work.

---

1. Laron, Z. and Kowadlo, A., "Fat mobilising effect of testosterone," *Metabolism*, **1963**, **12**, 588.
2. Norcia, L. N. and Evans, J. D., "Relation to plasma FFA composition to the origin of FFA from depot fat triglycerides," *Ibid.*, **1964**, **13**, 12.
3. Gallagher, T. F., Fukushima, D. K., Barry, M. C. and Dobriner, K., "Studies with isotopic steroid hormones," *Rec. Prog. Hor. Research*, **1951**, **6**, 131.
4. Vyas, M. K., "Origins of chyle cholesterol—demonstrated with the help of nuclear indicators," *Doctorate Thesis*, Paris University, 1962.

EFFECT OF POLYHEDROSIS ON THE HAEMOLYMPH TRANSAMINASES IN THE SILKWORM *BOMBYX MORI* L.

T. R. RAMAIAH AND T. VEERABASAPPA GOWDA

Department of Post-Graduate Studies and Research in Chemistry, Manasa Gangotri, University of Mysore, Mysore-6

INTRODUCTION

TRANSAMINASE activity is reported to be present in the tissues of silkworm, *Bombyx mori* L.[1-6] The activity is well defined in the silk gland, alimentary canal, muscle, fat body, and hæmolymph. It is reported that the inclusion of micro-quantities of the antibiotic chloromycetin in the diet of the silkworm results in a large increase in the transaminase activity in the hæmolymph and other tissues.[7] Antibiotic inclusion also improves the resistance against diseases like polyhedrosis (grasserie) and Flacherie.[7] Polyhedrosis attacks the silkworm larva at all its developmental stages[8]; it can also be induced by varying the conditions of rearing, like temperature,[9] humidity, nutrition,[10] and feeding of chemicals.[11] Polyhedrosis causes hypoproteinemia.[12] So it is interesting to study the effect of polyhedrosis on some key enzymes in the intermediary metabolism of proteins. This study was carried out to investigate the effect of polyhedrosis on the hæmolymph transaminases of the developed larva of *Bombyx mori* L.

MATERIALS AND METHODS

Larvæ of the silkworm were chosen in their fifth age just before spinning. They were picked up from the mountages when they were ready for spinning cocoons. The healthy larvæ and the grasserie-affected larvæ were collected in separate groups. The larvæ were pierced to bleed into 50 ml. capacity polythene centrifuge tubes placed in an ice-bath. The hæmolymph was centrifuged at 2,000 r.p.m. in an MSE refrigerated centrifuge at 4° C. for 30 min. The clear supernatant of the hæmolymph was dialised in a cellophane bag against several changes of phosphate buffer (pH 7·4) for 48 hr. at 4° C. The dialysed hæmolymph was used as enzyme source.

Isolation of Polyhedra.—The hæmolymph from grasserie-affected worms was centrifuged at 800 r.p.m. for 30 min. at 4° C. and the residue discarded. The supernatant was then recentrifuged at 3,000 r.p.m. for 1 hr. to obtain the residue (Residue I) of the polyhedral crystals and Supernatant I. Residue I was washed repeatedly with water and recentrifuged. Supernatant I was diluted with three times its volume of water to reduce the density of the liquid and centrifuged at 10,000 r.p.m. for 1 hr. which would completely sediment most of the polyhedral particles (Residue II), which were as before washed with water. Residues I and II were combined to provide the polyhedral preparation.

The amino-acids and the keto-acids and other chemicals employed were from commercial sources (BDH or E. Merck).

0·08 M solutions of the amino-acids and keto-acids were prepared in phosphate buffer (pH 7·4, containing 18·2 g. of $Na_2HPO_4.12H_2O$ and 1·81 g. KH_2PO_4 per litre). In the case of tryptophan and isoleucine which were difficult to dissolve in the buffer, the amino-acids were first dissolved in minimum amount of dilute alkali and solution made up to 0·08 M with the buffer.

$CdSO_4$ (0·08 M) was prepared in distilled water. Ninhydrin (0·01%) was prepared in acetone. Pyridoxal phosphate (200 μg./ml.) solution was prepared in the buffer.

The incubation mixture consisted of 0·25 ml. each of the amino-acid and keto-acid along with 0·1 ml. of pyridoxal phosphate and 0·25 ml. of the dialised hæmolymph. Control tubes did not contain the enzyme source which was added at the end of the incubation period just prior to stopping the reaction. The tubes were incubated at 37° C. for 1 hr. and then were transferred to boiling water-bath for 5 min.

The reaction mixture was centrifuged at 2,000 r.p.m. for 30 min. at 25° C. The clear supernatants were transferred into different sample tubes.

The supernatants were spotted on Whatman No. 1 paper for chromatography by means of a micro-pipette. Solutions of standard amino-acid were also spotted for reference. The chromatograms were developed either by using *n*-butanol, acetic acid and water (either 2 : 2 : 1 or 4 : 1 : 5) or phenol saturated with water. The chromatograms were dried at room temperature and were dipped in ninhydrin

solution. The spots were developed by heating the chromatogram at 80–85° C. for 3 mm. The coloured spots thus developed were cut out into strips. The strips were fixed between microscope slides and kept in an elution tank and were eluted into graduated tubes. To each tube, 0·05 ml. of $CdSO_4$ solution was added and the resulting colour read at 510 mμ in Beckman B spectrophotometer. The amount of amino-acid (alanine or glutamate) was calculated from a calibration curve set up with corresponding amino-acids. The transaminase activity was expressed as milligrams of amino-acid formed per ml. of the hæmolymph per hr. at 37° C.

The isolated polyhedral bodies were suspended in phosphate buffer (pH 7·4) and used as enzyme source for incubation in separate experiments.

RESULTS

It is observed that the activities of the enzymes glutamate-alanine, and glutamate-aspartate transaminases have increased nearly five times from the normal (Fig. 1). In normal animals, the aspartate-alanine transaminase and glutamate-alanine transaminase activities are extremely low and almost immeasurable. In diseased conditions, their activities increased 15-20 times. Of the several amino-acids tested for amino group donor activity (Table I) to either (*i*) pyruvate, or (*ii*) α-ketoglutarate, L-serine DL-threonine, L-lysine and DL-tryptophan do not appear to show any transfer activity to either pyruvate or α-ketoglutarate while glycine, DL-alanine and DL-methionine have only a trace amount of activity towards pyruvate as detected by chromatogram and none towards α-ketoglutarate. L-arginine and DL-phenylalanine similarly show trace amount of activity only in normal animals and none in grasserie-affected animals. DL-isoleucine, on the other hand, shows transfer activities in trace amounts towards α-ketoglutarate and none towards pyruvate. Only DL-alanine-α-ketoglutarate transaminase, L-glutamic acid-pyruvate transaminase and aspartic acid transami-

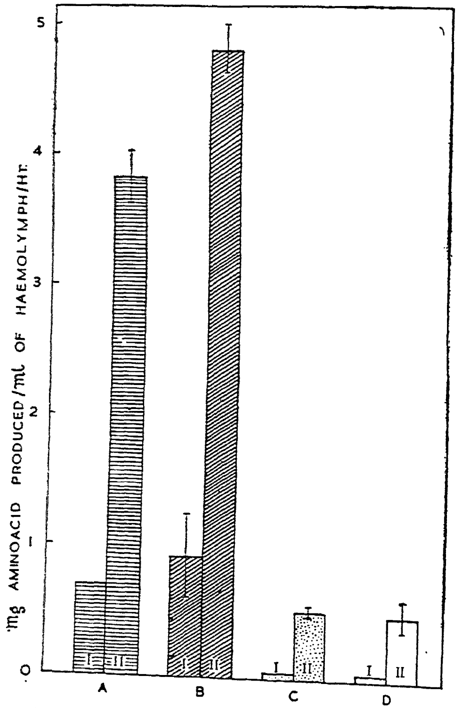


FIG. 1. A—Glutamate-alanine transaminase: (I) Normal, (II) Grasserie; B—Glutamate-aspartate transaminase: (I) Normal. (II) Grasserie; C—Alanine-aspartate transaminase: (I) Normal, (II) Grasserie; D—Glutamate-alanine transaminase: (I) Normal, (II) Grasserie.

TABLE I

Transaminase activity in the hæmolymph of normal and grasserie-affected larva of Bombyx mori *L.*

Sl. No.	Amino-acid		Keto-acid*	Presence of transaminase activity	
				Normal	Grasserei
1	L-Serine	..	(i)	–	–
			(ii)	–	–
2	DL-Threonine	..	(i)	–	–
			(ii)	–	–
3	L-Lysine	..	(i)	–	–
			(ii)	–	–
4	DL-Tryptophan	..	(i)	–	–
			(ii)	–	–
5	Glycine	..	(i)	–*	–*
			(ii)	–	–
6	DL-Valine	..	(i)	–*	–*
			(ii)	–	–
7	L-Arginine	..	(i)	–*	–
			(ii)	–	–
8	DL-Isoleucine	..	(i)	–	–*
			(ii)	–*	–*
9	DL-Methionine	..	(i)	–*	–*
			(ii)	–	–
10	DL-Phenylalanine	..	(i)	–*	–
			(ii)	–	–
11	DL-Histidine	..	(i)	–	–*
			(ii)	–*	–
12	DL-Alanine	..	(ii)	+	+
13	L-Glutamic acid	..	(i)	–*	+
14	DL-Aspartic acid	..	(i)	–*	+
			(ii)	+	+

* (i) Pyruvate, (ii) α-Ketoglutarate.

Note: – No activity; –* Extremely slight activity (not quantitatively measurable), + Activity measured quantitatively.

nation either with pyruvate or α-ketoglutarate could be measured quantitatively and significant increase in the activity of each of these enzymes has been shown in polyhedrosis (Fig. 1).

Incubation with isolated polyhedral bodies in place of enzyme showed no transaminase activities for glutamate aspartate, glutamate alanine and alanine aspartate even though these transaminases are abnormally high in the haemolymph of grasserie affected larvae.

DISCUSSION

Polyhedrosis of silkworm *Bombyx mori* L. is a very serious disease which completely destroys the capacity of the worm to produce silk. The disease has been shown to cause abnormal increase in the concentration of glutamic aspartate transaminase and of glutamic alanine transaminase activities. The equilibrium in each of these cases is far in the direction of glutamic acid formation. Several other transaminases (1) serine alanine, serine glutamic acid, (2) threonine alanine, threonine glutamic acid, (3) lysine alanine, lysine glutamic acid, and (4) tryptophan alanine, tryptophan glutamic acid are totally absent. The activity of the following transaminases is detectable only in trace amounts either in normal animals (a) or grasserie affected animals (b) [illegible]

(a) Glycine alanine, valine alanine, arginine alanine, isoleucine glutamic acid, methionine alanine and histidine glutamic acid. (b) Glycine alanine, valine alanine, isoleucine glutamic acid, methionine alanine and histidine alanine.

The only other enzyme which shows an abnormal increase in polyhedral attack even though it is present in trace amounts in normal animals is alanine aspartate transaminase. Since these enzymes are known to play a central role in protein metabolism, it is apparent that polyhedrosis which causes hypoproteinemia in the silkworm larva[12] will thus have an increased concentration of some of these enzymes. It is known that the concentration of transaminases increases when the silkworm is fed with micro-quantities of antibiotics like chloromycetin. However, silkworms have been known to [illegible] when treated with [illegible] showing an increased protein synthetic activity under these conditions. Polyhedrosis, on the other hand, causes hypoproteinemia and therefore the increased concentration of these enzymes might suggest increased protein degradative activity in the [illegible] for the elaboration of viral proteins and the multiplication of polyhedral viral particles.

Isolated polyhedra do not show any transaminase activities.

ACKNOWLEDGEMENT

The authors are thankful to Dr. [illegible], Central Sericultural Research and Training Institute, Mysore, for his interest and for having provided certain research facilities. They are also thankful to Dr. [illegible], Department of [illegible], University of Mysore, for valuable suggestions. Thanks are due to the Department of Atomic Energy, Government of India, Trombay, Bombay, for the award of a Research Assistantship to T. V. G. and for other financial assistance.

1. [illegible], H., [illegible], I., [illegible], H. and [illegible], K., *J. [illegible] Soc. Japan*, 1956, **30**, 257.
2. Fukuda, T. and Hayashi, Y., *J. Biochem. Tokyo*, 1958, **45**, 469.
3. —, *Ibid.*, 1957, **44**, 505.
4. [illegible], F., Nagayama, H. and [illegible], K., *J. Agric. Chem. Soc. Japan*, 1955, **29**, 987.
5. Bheemeswar, B., *Nature*, 1955, **176**, 555.
6. — and Sreenivasaya, M., *Curr. Sci.* (India), 1952, **21**, 253.
7. [illegible], M. B. and Bhat, J. V., *J. Sci. and Ind. Res.* (India), 1955, **14 C**, 97.
8. Hisao Aruga, *[illegible]*, 1957, **9** (1-2), 37.
9. Hukuhara, T. and Aruga, H., *J. Sericult. Sci.* (Japan), 1959, **28**, 235.
10. Aruga, H. and Nagashima, E., "On the relationship between incidence of polyhedral diseases and the nutritional conditions of the larval stage in the silkworm, *Bombyx mori* L." (In preparation.)
11. — and Hukuhara, T., *J. Seric. Sci.* (Japan), 1960, **29**, 44.
12. [illegible], M. I. and [illegible], I. I., *J. Insect Pathol.*, 1964, **6**, 517.

solution. The spots were developed by heating the chromatogram at 80–85° C. for 3 mm. The coloured spots thus developed were cut out into strips. The strips were fixed between microscope slides and kept in an elution tank and were eluted into graduated tubes. To each tube, 0·05 ml. of $CdSO_4$ solution was added and the resulting colour read at 510 mμ in Beckman B spectrophotometer. The amount of amino-acid (alanine or glutamate) was calculated from a calibration curve set up with corresponding amino-acids. The transaminase activity was expressed as milligrams of amino-acid formed per ml. of the hæmolymph per hr. at 37° C.

The isolated polyhedral bodies were suspended in phosphate buffer (pH 7·4) and used as enzyme source for incubation in separate experiments.

RESULTS

It is observed that the activities of the enzymes glutamate-alanine, and glutamate-aspartate transaminases have increased nearly five times from the normal (Fig. 1). In normal animals, the aspartate-alanine transaminase and glutamate-alanine transaminase activities are extremely low and almost immeasurable. In diseased conditions, their activities increased 15–20 times. Of the several amino-acids tested for amino group donor activity (Table I) to either (*i*) pyruvate, or (*ii*) α-ketoglutarate, L-serine DL-threonine, L-lysine and DL-tryptophan do not appear to show any transfer activity to either pyruvate or α-ketoglutarate while glycine, DL-alanine and DL-methionine have only a trace amount of activity towards pyruvate as detected by chromatogram and none towards α-ketoglutarate. L-arginine and DL-phenylalanine similarly show trace amount of activity only in normal animals and none in grasserie-affected animals. DL-isoleucine, on the other hand, shows transfer activities in trace amounts towards α-ketoglutarate and none towards pyruvate. Only DL-alanine-α-ketoglutarate transaminase, L-glutamic acid-pyruvate transaminase and aspartic acid transami-

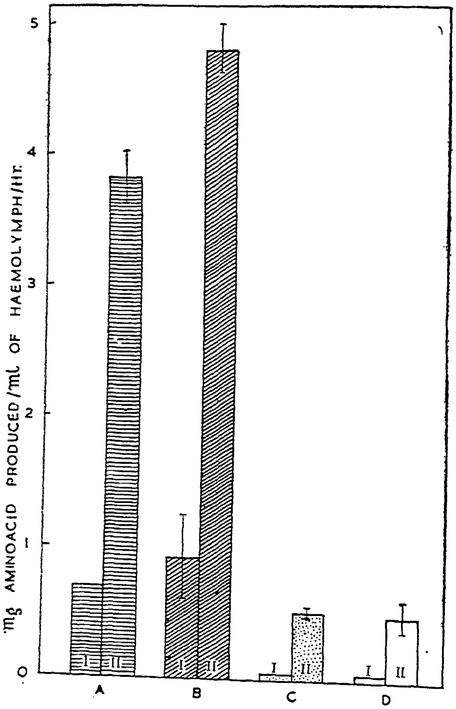


FIG. 1. A—Glutamate-alanine transaminase: (I) Normal, (II) Grasserie; B—Glutamate-aspartate transaminase: (I) Normal, (II) Grasserie; C—Alanine-aspartate transaminase: (I) Normal, (II) Grasserie; D—Glutamate-alanine transaminase; (I) Normal, (II) Grasserie.

TABLE I

Transaminase activity in the hæmolymph of normal and grasserie-affected larva of Bombyx mori *L.*

Sl. No.	Amino-acid		Keto-acid*	Presence of transaminase activity	
				Normal	Grasserei
1	L-Serine	..	(i)	–	–
			(ii)	–	–
2	DL-Threonine	..	(i)	–	–
			(ii)	–	–
3	L-Lysine	..	(i)	–	–
			(ii)	–	–
4	DL-Tryptophan	..	(i)	–	–
			(ii)	–	–
5	Glycine	..	(i)	–*	–*
			(ii)	–	–
6	DL-Valine	..	(i)	–*	–*
			(ii)	–	–
7	L-Arginine	..	(i)	–*	–
			(ii)	–	–
8	DL-Isoleucine	..	(i)	–	–*
			(ii)	–*	–*
9	DL-Methionine	..	(i)	–*	–*
			(ii)	–	–
10	DL-Phenylalanine	..	(i)	–*	–
			(ii)	–	–
11	DL-Histidine	..	(i)	–	–*
			(ii)	–*	–
12	DL-Alanine	..	(ii)	+	+
13	L-Glutamic acid	..	(i)	–*	+
14	DL-Aspartic acid	..	(i)	–*	+
			(ii)	+	+

* (i) Pyruvate, (ii) α-Ketoglutarate.

Note: – No activity; –* Extremely slight activity (not quantitatively measurable), + Activity measured quantitatively.

nation either with pyruvate or α-ketoglutarate could be measured quantitatively and significant increase in the activity of each of these enzymes has been shown in polyhedrosis (Fig. 1).

Incubation with isolated polyhedral body in place of enzyme showed no transaminase activities for glutamate-aspartate, glutamate-alanine and alanine-aspartate even though these transaminases are abnormally high in the haemolymph of grasserie-affected larvae.

DISCUSSION

Polyhedrosis of silkworm *Bombyx mori* L. is a very serious disease which completely destroys the capacity of the worm to produce silk. The disease has been shown to cause abnormal increase in the concentration of glutamic-aspartate transaminase and of glutamic alanine transaminase activities. The equilibrium in each of these cases is far in the direction of glutamic acid formation. Several other transaminases: (1) serine-alanine; serine-glutamic acid, (2) threonine-alanine; threonine-glutamic acid; (3) lysine-alanine; lysine-glutamic acid; and (4) tryptophan-alanine; tryptophan-glutamic acid are totally absent. The activity of the following transaminases is detectable only in trace amounts either in normal animals (a) or grasserie affected animals (b).

(a) Glycine-alanine; valine-alanine; arginine-alanine, isoleucine-glutamic acid; methionine-alanine and histidine-glutamic acid. (b) Glycine-alanine, valine-alanine; isoleucine-glutamic acid; methionine-alanine and histidine-alanine.

The only other enzyme which shows an abnormal increase in polyhedral attack even though it is present in trace amounts in normal animals is alanine-aspartate transaminase. Since these enzymes are known to play a central role in protein metabolism, it is apparent that polyhedrosis which causes hypoproteinemia in the *noctuide* larva[12] will thus have an increased concentration of some of these enzymes. It is known that the concentration of transaminases increases when the silkworm is fed with micro-quantities of antibiotics like chloromycetin. However, silkworms have been shown to yield more silk when treated with chloromycetin suggesting an increased protein anabolic activity under these conditions. Polyhedrosis, on the other hand, causes hypoproteinemia and, therefore, the increased concentration of these enzymes might suggest increased protein degradative activity in the host, thus facilitating the production of viral proteins and the multiplication of polyhedral viral particles.

Isolated polyhedra do not show any transaminase activities.

ACKNOWLEDGEMENT

The authors are thankful to Dr. N. S. Sidhu, Central Sericultural Research and Training Institute, Mysore, for his interest and for having provided certain research facilities. They are also thankful to Dr. H. S. Seshadri, Department of Chemistry, University of Mysore, for valuable suggestions. Thanks are due to the Department of Atomic Energy, Government of India, Trombay, Bombay, for the award of a Research Assistantship to T. V. G. and for other financial assistance.

1. Koide, H., Shishido, T., Nagayama, H. and Shimura, K., *J. Agri. Chem. Soc.* (Japan), 1956, **30**, 283.
2. Fukuda, T. and Hayashi, T., *J. Biochem.* (Tokyo), 1958, **45**, 469.
3. *Ibid.*, 1957 **44**, 505.
4. Koide, F., Nagayama, H. and Shimura, K., *J. Agri. Chem. Soc.* (Japan), 1955, **29**, 987.
5. Bheemeswar, B., *Nature*, 1955, **176**, 555.
6. and Sreenivasaya, M., *Curr. Sci.* (India), 1952, **21**, 253.
7. Shyamala, M. B. and Bhat, J. V., *J. Sci. and Ind. Res.* (India), 1955, **14 C**, 97.
8. Hisao Aruga, *Jour. Silkworm T.I.*, 1957, **9** (1 2), 37.
9. Hukuhara, T. and Aruga, H., *J. Sericult. Sci.* (Japan), 1959, **28**, 235.
10. Aruga, H. and Nagashima, E., "On the relationship between incidence of polyhedral diseases and the nutritional conditions during larval stage in the silkworm *Bombyx mori* L." (In preparation).
11. and Hukuhara, T., *J. Seri. Sci.* (Japan), 1960, **29**, 44.
12. Mortignoni, M. E. and Milstead, J. E., *J. Insect Pathol.*, 1964, **6**, 517.

solution. The spots were developed by heating the chromatogram at 80–85° C. for 3 mm. The coloured spots thus developed were cut out into strips. The strips were fixed between microscope slides and kept in an elution tank and were eluted into graduated tubes. To each tube, 0·05 ml. of $CdSO_4$ solution was added and the resulting colour read at 510 mμ in Beckman B spectrophotometer. The amount of amino-acid (alanine or glutamate) was calculated from a calibration curve set up with corresponding amino-acids. The transaminase activity was expressed as milligrams of amino-acid formed per ml. of the hæmolymph per hr. at 37° C.

The isolated polyhedral bodies were suspended in phosphate buffer (pH 7·4) and used as enzyme source for incubation in separate experiments.

RESULTS

It is observed that the activities of the enzymes glutamate-alanine, and glutamate-aspartate transaminases have increased nearly five times from the normal (Fig. 1). In normal animals, the aspartate-alanine transaminase and glutamate-alanine transaminase activities are extremely low and almost immeasurable. In diseased conditions, their activities increased 15–20 times. Of the several amino-acids tested for amino group donor activity (Table I) to either (*i*) pyruvate, or (*ii*) α-ketoglutarate, L-serine DL-threonine, L-lysine and DL-tryptophan do not appear to show any transfer activity to either pyruvate or α-ketoglutarate while glycine, DL-alanine and DL-methionine have only a trace amount of activity towards pyruvate as detected by chromatogram and none towards α-ketoglutarate. L-arginine and DL-phenylalanine similarly show trace amount of activity only in normal animals and none in grasserie-affected animals. DL-isoleucine, on the other hand, shows transfer activities in trace amounts towards α-ketoglutarate and none towards pyruvate. Only DL-alanine-α-ketoglutarate transaminase, L-glutamic acid-pyruvate transaminase and aspartic acid transami-

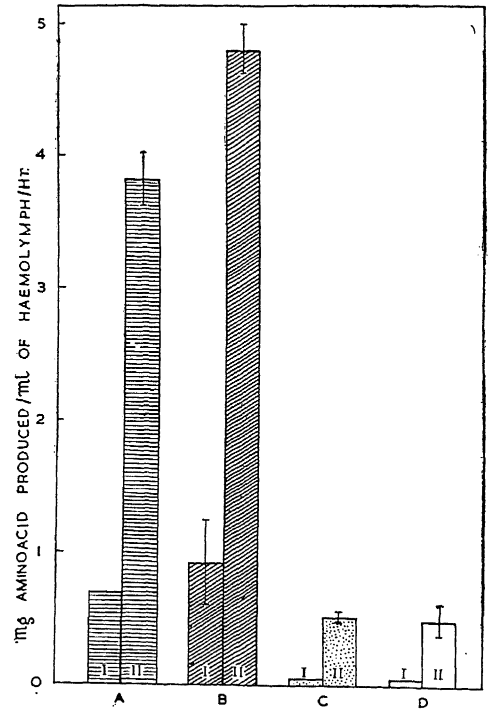


FIG. 1. A—Glutamate-alanine transaminase: (I) Normal, (II) Grasserie; B—Glutamate-aspartate transaminase: (I) Normal, (II) Grasserie; C—Alanine-aspartate transaminase: (I) Normal, (II) Grasserie; D—Glutamate-alanine transaminase; (I) Normal, (II) Grasserie.

TABLE I

Transaminase activity in the hæmolymph of normal and grasserie-affected larva of Bombyx mori *L.*

Sl. No.	Amino-acid		Keto-acid*	Presence of transaminase activity	
				Normal	Grasserei
1	L-Serine	..	(i)	–	–
			(ii)	–	–
2	DL-Threonine	..	(i)	–	–
			(ii)	–	–
3	L-Lysine	..	(i)	–	–
			(ii)	–	–
4	DL-Tryptophan	..	(i)	–	–
			(ii)	–	–
5	Glycine	..	(i)	–*	–*
			(ii)	–	–
6	DL-Valine	..	(i)	–*	–*
			(ii)	–	–
7	L-Arginine	..	(i)	–*	–
			(ii)	–	–
8	DL-Isoleucine	..	(i)	–	–*
			(ii)	–*	–*
9	DL-Methionine	..	(i)	–*	–*
			(ii)	–	–
10	DL-Phenylalanine	..	(i)	–*	–
			(ii)	–	–
11	DL-Histidine	..	(i)	–	–*
			(ii)	–*	–
12	DL-Alanine	..	(ii)	+	+
13	L-Glutamic acid	..	(i)	–*	+
14	DL-Aspartic acid	..	(i)	–*	+
			(ii)	+	+

* (i) Pyruvate, (ii) α-Ketoglutarate.

Note: – No activity; –* Extremely slight activity (not quantitatively measurable), + Activity measured quantitatively.

nation either with pyruvate or α-ketoglutarate could be measured quantitatively and significant increase in the activity of each of these enzymes has been shown in polyhedrosis (Fig. 1).

Incubation with isolated polyhedral body in place of enzyme showed no transaminase activities for glutamate-aspartate, glutamate-alanine and alanine-aspartate even though these transaminases are abnormally high in the hæmolymph of grasserie-affected larvæ.

DISCUSSION

Polyhedrosis of silkworm *Bombyx mori* L. is a very serious disease which completely destroys the capacity of the worm to produce silk. The disease has been shown to cause abnormal increase in the concentration of glutamic-aspartate transaminase and of glutamic-alanine transaminase activities. The equilibrium in each of these cases is far in the direction of glutamic acid formation. Several other transaminases: (1) serine-alanine; serine-glutamic acid, (2) threonine-alanine; threonine-glutamic acid; (3) lysine-alanine; lysine-glutamic acid; and (4) tryptophan-alanine; tryptophan-glutamic acid are totally absent. The activity of the following transaminases is detectable only in trace amounts either in normal animals (*a*) or grasserie-affected animals (*b*).

(*a*) Glycine-alanine; valine-alanine; arginine-alanine; isoleucine-glutamic acid; methionine-alanine and histidine-glutamic acid. (*b*) Glycine-alanine; valine-alanine; isoleucine-glutamic acid; methionine-alanine and histidine-alanine.

The only other enzyme which shows an abnormal increase in polyhedral attack even though it is present in trace amounts in normal animals is alanine-aspartate transaminase. Since these enzymes are known to play a central role in protein metabolism, it is apparent that polyhedrosis which causes hypoproteinemia in the *noctuide* larva[12] will thus have an increased concentration of some of these enzymes. It is known that the concentration of transaminases increases when the silkworm is fed with micro-quantities of antibiotics like chloromycetin. However, silkworms have been shown to yield more silk when treated with chloromycetin suggesting an increased protein anabolic activity under these conditions. Polyhedrosis, on the other hand, causes hypoproteinemia and, therefore, the increased concentration of these enzymes might suggest increased protein degradative activity in the host, thus facilitating the production of viral proteins and the multiplication of polyhedral viral particles.

Isolated polyhedra do not show any transaminase activities.

ACKNOWLEDGEMENT

The authors are thankful to Dr. N. S. Sidhu, Central Sericultural Research and Training Institute, Mysore, for his interest and for having provided certain research facilities. They are also thankful to Dr. H. S. Seshadri, Department of Chemistry, University of Mysore, for valuable suggestions. Thanks are due to the Department of Atomic Energy, Government of India, Trombay, Bombay, for the award of a Research Assistantship to T. V. G. and for other financial assistance.

---

1. Koide, H., Shishido. T., Nagayama, H. and Shimura, K., *J. Agri. Chem. Soc.* (Japan), 1956, **30**, 283.
2. Fukuda, T. and Hayashi, T., *J. Biochem.* (Tokyo), 1958, **45**, 469.
3. —, *Ibid.*, 1957 **44**, 505.
4. Koide, F., Nagayama, H. and Shimura, K., *J. Agri. Chem. Soc.* (Japan), 1955, **29**, 987.
5. Bheemeswar, B., *Nature*, 1955, **176**, 555
6. — and Sreenivasaya, M., *Curr. Sci.* (India), 1952, **21**, 253.
7. Shyamala, M. B. and Bhat, J. V., *J. Sci. and Ind. Res.* (India), 1955, **14 C**, 97.
8. Hisao Aruga, *Jour. Silkworm T.I.*, 1957, **9** (1-2), 37.
9. Hukuhara, T. and Aruga, H., *J. Sericult. Sci.* (Japan), 1959, **28**, 235.
10. Aruga, H. and Nagashima, E., "On the relationship between incidence of polyhedral diseases and the nutritional conditions during larval stage in the silkwrom *Bombyx mori* L." (In preparation).
11. — and Hukuhara, T., *J. Seri. Sci.* (Japan), 1960, **29**, 44.
12. Mortignoni, M. E. and Milstread, J. E., *J. Insect pathol.*, 1964, **6**, 517.

LETTERS TO THE EDITOR

A NEW BAND SYSTEM OF GeBr IN THE VISIBLE REGION

IN the course of our recent investigations on the halide spectra of the IV A group elements a new characteristic emission spectrum attributable to diatomic germanium monobromide has been recorded in the visible region. The spectrum has been observed in emission by exciting a mixture of germanium tetrabromide vapour and argon by an r.f. discharge from a 1/2 K.W. oscillator. The colour of the discharge free from impurities is intense green. Figure 1 is the reproduction of the spectrum recorded on Fuess spectrograph. The spectrum reveals characteristic red degraded bands extending from λλ 5540–4500 Å in addition to those already reported in the ultraviolet region (Jevons *et al.*[1]; Andrews and Barrow[2]). These bands are found to be emitted only when argon is admitted into the discharge tube and the partial pressures of $GeBr_4$ vapour and argon are suitably adjusted. In the absence of argon the spectrum shows a continuum in this region.

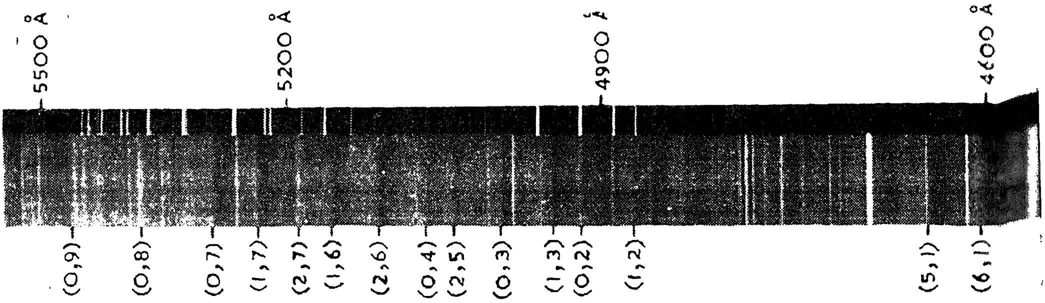


FIG. 1. New emission spectrum of GeBr in the region λλ 5540–4500 Å.

It is found possible to analyse these bands into a single system. The vibrational constants are derived as follows:

$$\nu = 20967 + 190\cdot2\,(v' + \tfrac{1}{2}) - 1\cdot1_5\,(v' + \tfrac{1}{2})^2 - 296\cdot0\,(v'' + \tfrac{1}{2}) + 0\cdot8_5\,(v'' + \tfrac{1}{2})^2.$$

By analogy with GeCl and SiBr[3,4] and from the near equality of the vibrational constants the lower state of this new system is identified as $X^2\Pi_{\frac{1}{2}}$ state of the GeBr molecule. The electronic transition involved is tentatively assigned as $A^2\Sigma – X^2\Pi_{\frac{1}{2}}$ of the GeBr molecule,

Spectroscopy Laboratories,
Department of Physics,
Andhra University,
Waltair, *September* 8, 1969.

K. BABU R
P. B. V. HA

---

1. Jevons, W., Bashford, L. A. and Briscoe, *Proc. Phys. Soc. (London)*, 1937, **49**,
2. Andrews, E. B. and Barrow, R. F., *Ibid.*, 957.
3. Babu Rao, K. and Haranath, P. B. V., *J. (London)*, 1969, **2**, 1080.
4. — and —, *Ibid.* (In press):

MORPHOLOGY OF HILLSTREAMS

MEANDERING in streams has been a sub much study. Observations lead to the ence that the meandering pattern is more than a straight reach in streams oth comparable.[1] Alluvial streams have a me ing pattern which is shown to be ess related to the existing hydrological, to phical and textural (composition of th load and the banks) conditions of that reg

An attempt is made here to study the sity of hillstreams and their relation to h logy and topography. Hillstreams are draining hillslopes with medium to high dient and without appreciable bank mat an alluvial nature. The measure of the tion of the stream from the straightness sinuosity index (P) which is the ratio channel length to corresponding valley le A length of ten miles of each of the under study is measured as follows enlarged topographic maps with a chartometer: (i) five miles on either direction of the gauging point, upstream and downstream along the principal stream, or (ii) if the gauging point is less than five miles from a point upstream where it attains the Strahler's order of stream segment under study or a point downstream where the order becomes higher, the length is measured through the gauging point moving downstream or upstream respectively. The maximum discharge in a year is taken as the measure representing the hydrologic behaviour of the streams, while the gradient of the stream segment in feet per mile is considered to reflect the topography. All the thirteen streams studied here are those draining the slopes of the Nilgiri Hills in South India.

The sinuosity (P) ranges from 1·13 to 1·80, the maximum discharge (Q_{max}) from 87 to 3,061 cusecs and the gradient of the streams (S) from 91 to 1,120 ft/ml. The values of the variables for the thirteen streams are plotted on a log-log graph paper with regression lines fitted by eye (Fig. 1). Correlation coefficients for sinuosity and gradient and for sinuosity and maximum discharge of the streams are determined by standard statistical methods. The coefficients of correlation obtained are ·24 for sinuosity and maximum discharge and ·06 for sinuosity and gradient of the stream.

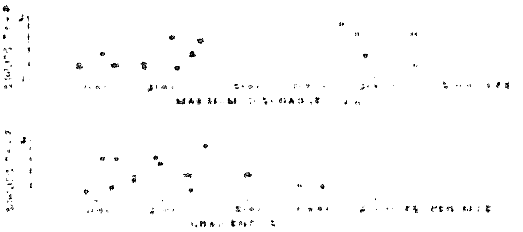


FIG. 1. Relation of sinuosity to maximum discharge and gradient of the streams.

This study reveals that not much of variation in sinuosity of hillstreams can be explained either by the variation in the discharge or the gradient of the streams. It might, however, be expected from the correlation coefficients determined that as discharge increases, the sinuosity of the stream increases and *vice versa*. Similarly, it can be expected that as the gradient of the stream increases or becomes steeper, the sinuosity of the stream tends to lower or the stream is likely to be much straighter than otherwise.

Relation between certain other of the morphometric characteristics and hydrology for the same streams is found to be fairly well related by the authors. These are total length of the streams in the basin, the area of the basin, circularity (a measure of the shape) of the basin, and discharge (data to be published elsewhere). Sinuosity, as the present study has shown, cannot be included in the above measures to arrive at a satisfactory estimate of the stream discharge at ungauged points as it is possible with the other morphometric characteristics, particularly for the hillstreams.

Our thanks are due to Dr. R. Vaidyanadhan for guidance, and to the C.S.I.R. for financial assistance. Discharge data of the streams used here was kindly provided by the Tamil Nadu Electricity Board.

Geology Dept., Y. J. PARDHASARADHI
Andhra University, K. L. V. RAMANA RAO.
Waltair, *September* 1, 1969.

1. Langbein, W. B. and Leopold, L. B., *U.S. Geological Survey Prof. Paper*, 1962, p. 422 H.
2. Schumm, S. A., *Geol. Soc. Am. Bull.*, 1963, **74**, 1089.
3. , *Science*, 1967, **157**, 1549.
4. Dury, G. H., *U.S. Geological Survey Prof. Paper* 1965, p. 425 C.
5. Carlston, C. W., *Am. Jour. Sci.*, 1965, **263**, 864.

ON THE PRESENCE OF PILA-LATERALIS IN *TILAPIA MOSSAMBICA* (PETERS)

DURING the course of the developmental and morphological studies on the skull of *Tilapia mossambica* the author has recorded the occurrence of a pila lateralis, to be arising in the 18 mm. stage as a small ventromesial extension from the post-orbital cartilage. At this stage the orbital cartilage has become very much reduced due to the process of continuous absorption of the cartilage and is about to become discontinuous. The post-orbital cartilage does not present any signs of absorption yet. In the 27 mm. stage it is further reduced and becomes discontinuous. During the course of development the pila-lateralis grows in size obliquely filling the gap between the post-orbital cartilage and the prootic bridge enclosing the trigeminal foramen. Finally, it grows to its maximum by the 45 mm. stage. Due to its presence, the sphenoidal fissure becomes reduced in size from behind.

In the development of the piscine chondrocranium, lateral outgrowths from the orbital cartilages, forming the lateral walls supporting the cranium in the orbital region, are not uncommon. The presence of a pila-lateralis has been reported till now only in *Amia* (Allis, 1897)

LETTERS TO THE EDITOR

A NEW BAND SYSTEM OF GeBr IN THE VISIBLE REGION

In the course of our recent investigations on the halide spectra of the IV A group elements a new characteristic emission spectrum attributable to diatomic germanium monobromide has been recorded in the visible region. The spectrum has been observed in emission by exciting a mixture of germanium tetrabromide vapour and argon by an r.f. discharge from a 1/2 K.W. oscillator. The colour of the discharge free from impurities is intense green. Figure 1 is the reproduction of the spectrum recorded on Fuess spectrograph. The spectrum reveals characteristic red degraded bands extending from λλ 5540–4500 Å in addition to those already reported in the ultraviolet region (Jevons *et al.*[1]; Andrews and Barrow[2]). These bands are found to be emitted only when argon is admitted into the discharge tube and the partial pressures of $GeBr_4$ vapour and argon are suitably adjusted. In the absence of argon the spectrum shows a continuum in this region.

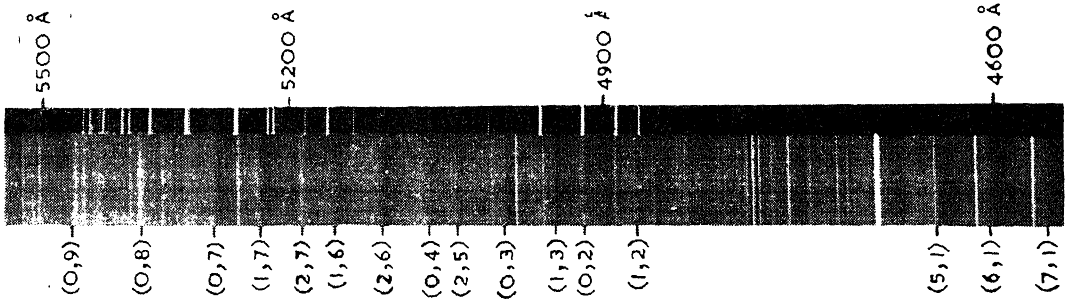


FIG. 1. New emission spectrum of GeBr in the region λλ 5540–4500 Å.

It is found possible to analyse these bands into a single system. The vibrational constants are derived as follows:

$$\nu = 20967 + 190\cdot 2\,(v' + \tfrac{1}{2}) - 1\cdot 1_5\,(v' + \tfrac{1}{2})^2 - 296\cdot 0\,(v'' + \tfrac{1}{2}) + 0\cdot 8_5\,(v'' + \tfrac{1}{2})^2.$$

By analogy with GeCl and SiBr[3,4] and from the near equality of the vibrational constants the lower state of this new system is identified as $X^2\Pi_{\frac{1}{2}}$ state of the GeBr molecule. The electronic transition involved is tentatively assigned as $A^2\Sigma$–$X^2\Pi_{\frac{1}{2}}$ of the GeBr molecule.

Spectroscopy Laboratories, K. Babu Rao.
Department of Physics, P. B. V. Haranath.
Andhra University,
Waltair, *September* 8, 1969.

---

1. Jevons, W., Bashford, L. A. and Briscoe, H. V. A., *Proc. Phys. Soc. (London)*, 1937, **49**, 532.
2. Andrews, E. B. and Barrow, R. F., *Ibid.*, 1950, **63**, 957.
3. Babu Rao, K. and Haranath, P. B. V., *J. Phys. B (London)*, 1969, **2**, 1080.
4. — and —, *Ibid.* (In press).

MORPHOLOGY OF HILLSTREAMS

Meandering in streams has been a subject of much study. Observations lead to the inference that the meandering pattern is more stable than a straight reach in streams otherwise comparable.[1] Alluvial streams have a meandering pattern which is shown to be essentially related to the existing hydrological, topographical and textural (composition of the bed load and the banks) conditions of that region.[2–5]

An attempt is made here to study the tortuosity of hillstreams and their relation to hydrology and topography. Hillstreams are those draining hillslopes with medium to high gradient and without appreciable bank material of an alluvial nature. The measure of the deviation of the stream from the straightness is the sinuosity index (P) which is the ratio of the channel length to corresponding valley length.[2] A length of ten miles of each of the stream under study is measured as follows from enlarged topographic maps with a rhartometer: (*i*) five miles on either direction of the gauging point, upstream and downstream along the principal stream, or (*ii*) if the gauging point is less than five miles from a point upstream where it attains the Strahler's order of stream segment under study or a point downstream where the order becomes higher, the length is measured through the gauging point moving downstream or upstream respectively. The maximum discharge in a year is taken as the measure representing the hydrologic behaviour of the streams, while the gradient of the stream segment in feet per mile is considered to reflect the topography. All the thirteen streams studied here are those draining the slopes of the Nilgiri Hills in South India.

The sinuosity (P) ranges from 1·13 to 1·80, the maximum discharge (Q_m) from 87 to 3,061 cusecs and the gradient of the streams (S) from 91 to 1,120 ft./ml. The values of the variables for the thirteen streams are plotted on a log-log graph-paper with regression lines fitted by eye (Fig. 1). Correlation coefficients for sinuosity and gradient and for sinuosity and maximum discharge of the streams are determined by standard statistical methods. The coefficients of correlation obtained are ·24 for sinuosity and maximum discharge and — ·06 for sinuosity and gradient of the stream.

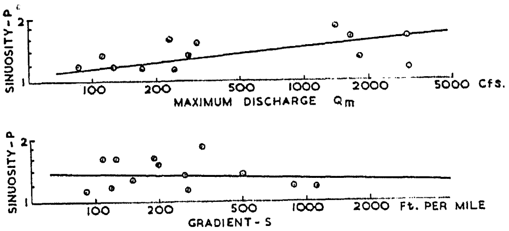


FIG. 1. Relation of sinuosity to maximum discharge and gradient of the streams.

This study reveals that not much of variation in sinuosity of hillstreams can be explained either by the variation in the discharge or the gradient of the streams. It might, however, be expected from the correlation coefficients determined that as discharge increases, the sinuosity of the stream increases and *vice versa*. Similarly, it can be expected that as the gradient of the stream increases or becomes steeper, the sinuosity of the stream tends to lower or the stream is likely to be much straighter than otherwise.

Relation between certain other of the morphometric characteristics and hydrology for the same streams is found to be fairly well related by the authors. These are total length of the streams in the basin, the area of the basin, circularity (a measure of the shape) of the basin, and discharge (data to be published elsewhere). Sinuosity, as the present study has shown, cannot be included in the above measures to arrive at a satisfactory estimate of the stream discharge at ungauged points as it is possible with the other morphometric characteristics, particularly for the hillstreams.

Our thanks are due to Dr. R. Vaidyanadhan for guidance, and to the C.S.I.R. for financial assistance. Discharge data of the streams used here was kindly provided by the Tamil Nadu Electricity Board.

Geology Dept., Y. J. PARDHASARADHI.
Andhra University, K. L. V. RAMANA RAO.
Waltair, *September* 1, 1969.

---

1. Langbein, W. B. and Leopold, L. B., *U.S. Geological Survey Prof. Paper*, 1962, p. 422-H.
2. Schumm, S. A., *Geol. Soc. Am. Bull.*, 1963, **74**, 1089.
3. —, *Science*, 1967, **157**, 1549.
4. Dury, G. H., *U.S. Geological Survey Prof. Paper* 1965, p. 425-C.
5. Carlston, C. W., *Am. Jour. Sci.*, 1965, **263**, 864.

ON THE PRESENCE OF PILA-LATERALIS IN *TILAPIA MOSSAMBICA* (PETERS)

DURING the course of the developmental and morphological studies on the skull of *Tilapia mossambica* the author has recorded the occurrence of a pila-lateralis, to be arising in the 18 mm. stage as a small ventromesial extension from the post-orbital cartilage. At this stage the orbital cartilage has become very much reduced due to the process of continuous absorption of the cartilage and is about to become discontinuous. The post-orbital cartilage does not present any signs of absorption yet. In the 27 mm. stage it is further reduced and becomes discontinuous. During the course of development the pila-lateralis grows in size obliquely filling the gap between the post-orbital cartilage and the prootic bridge enclosing the trigeminal foramen. Finally, it grows to its maximum by the 45 mm. stage. Due to its presence, the sphenoidal fissure becomes reduced in size from behind.

In the development of the piscine chondrocranium, lateral outgrowths from the orbital cartilages, forming the lateral walls supporting the cranium in the orbital region, are not uncommon. The presence of a pila-lateralis has been reported till now only in *Amia* (Allis, 1897) and *Mastecembelus* (Bhargava, 1958). In these cases it arises at the 31·5 mm. and 21·6 mm. stages respectively. In *Tilapia mossambica* it arises at the 18 mm. stage and reaches obliquely upto the prootic bridge as in *Amia* and *Mastacembelus*. Although pila-lateralis is present in the above three fishes, they do not resemble closely otherwise and hence its presence is of little phylogenetic significance.

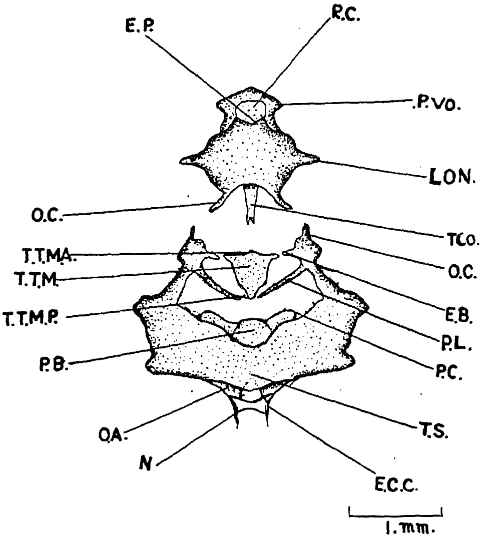


FIG. 1. Dorsal view of the chondrocranium of *T. mossambica*. 45·0 mm in length, almost resembling the adult stage (by graphical reconstruction). E.B.—Remnants of epiphysial bar; E.C.C.—Epichordal commissure; E.P.—Ethmoid plate; L.O.N.—Lamina orbito nasalis; N.—Notochord; O.A.—Occipital arch; O.C.—Remnants of orbital cartilage; P.B.—Prootic bridge; P.C.—Parachordal; P.L.—Pila-lateralis; P.Vo.—Extension of Prevomer; R.C.—Rostral cartilage; T.Co.—Trabecula communis; T.S.—Tectum synoticum; T.T.M.—Tænia Tecti Medialis; T.T.M.A.—Tænia Tecti Medialis Anterius; T.T.M.P.—Tænia Tecti Medialis Posterius.

Zoological Laboratories, K. Seetha Rao.
University of Indore,
Indore (M.P.), *July* 16, 1969.

---

1. Allis, E. P., *J. Morph.*, 1897, **12**, 487.
2. Bhargava, H. N., *Ibid.*, 1958, p. 403.
3. de Beer, G. R., Oxford, 1937.

ON THE OCCURRENCE OF *SIPHONOSOMA AUSTRALE* (KEFERSTEIN) AT THE VISAKHAPATNAM HARBOUR

While engaged in studying the benthic fauna in the Visakhapatnam harbour we have frequently come across large numbers of a Sipunculid, *Siphonosoma australe* (Keferstein) in the intertidal region of the harbour in the Southern Lighter Channel. Existing records[5] show that the salinity varies from 5·85‰ (October) to 33·43‰ (March) in this area and the water is also highly polluted with effluents from the town's sewage. The oxygen concentration never goes above 4 ml./L. and very often the worms are subjected to practically anoxic conditions. The temperature ranges from 26° C. to 30·7° C. in December and May respectively. The polychæte worm *Marphysa gravelyi* and an oligochæte, *Pontodrilus bermudensis* live in the same habitat as the sipunculid. The substratum where the sipunculid is found is an admixture of sand and mud in about equal parts with small pebbles interspersed.

All available information show that most sipunculids are exclusively marine in distribution.[7,9] In his investigations on the fauna of the brackish parts of the Baltic Sea, Fischer[4] even commented that the members of the phylum Sipuncula were absent in the brackish zones and increased in numbers from Skagerrak with increasing salinities (at least 30‰) into the North Sea. *Siphonosoma australe* has a wide distribution and has been reported from Sydney, Australia[2]; the Philippines; Fiji; Loyalty Islands; Amboina; Zanzibar; Gulf of Mannar; Samoa; and New Zealand[3] (*see* Prashad, 1936 and Edmonds, 1961 for relevant literature). Along the Indian coasts, Gravely[6] first reported its occurrence under the name *Sipunculus australis* Keferstein from the Gulf of Mannar "in mud exposed at low water on the west side of the Porites Bay" and later Prashad[8] assigned it to the species *Siphonosoma australe* (Keferstein) in his report on the Indian Sipunculoidea. The recent report of *Siphonosoma australe* from Madagascar[1] also indicates that in the habitat from where the worms were collected salinity ranged from 29·05‰ to 35·57‰. Cutler[1] commenting on the hydrographical conditions of the stations from where the two genera *Sipunculus* and *Siphonosoma* were collected has observed that of the two genera *Siphonosoma* may be much more tolerant than *Sipunculus* with regard to at least three parameters: temperature, salinity and oxygen. Our observations have largely confirmed Cutler's assumption.

We are grateful to Dr. Edmonds, University of Adelaide, Australia. for confirming the identification of the Sipunculid. One of us (Subba Rao) is indebted to the Council of Scientific and Industrial Research for the award of a Research Fellowship during the

tenure of which the above work was undertaken.

Dept. of Zoology, P. N. Ganapati.
Andhra University, B. V. S. S. R. Subba Rao.
Waltair, *August* 28, 1969.

---

1. Cutler, E. B., *Cah. O.R.S.T.O.M. Oceanogr.*, 1965, **3**, 451.
2. Edmonds, S. J., *Aust. J. Mar. Freshw. Res.*, 1955, **6**, 82.
3. —, *Ann. Mag. Nat. Hist.*, 1961, **13** (4), 217.
4. Fischer, W., *Die Tierwelt der Nord- und Ostsee*, Teil VI d, 1925.
5. Ganapati *et al.*, *Andhra Univ. Mem. Oceanogr.*, 1958, **62** (2), 193.
6. Gravely, F. H., *Bull. Madras Govt. Mus.*, 1927, **1** (1), 87.
7. Hyman, L. H., *The Invertebrates*, Vol. V, McGraw Hill, New York, 1959, p. 610.
8. Prashad, B., *Rec. Indian Mus.*, 1936, **38**, 231.
9. Tetry, A., *Traité de Zoologie*, Tome V (Premier Fascicule), Masson, Paris, 1959, p. 785.

HAPLORCHIASIS TAICHUI IN PARIAH DOGS

Haplorchiasis taichui has been reported from cat, fox and dogs in India, but information on the pathology of its infection is lacking. During the survey of helminth parasites of dogs at Bareilly about 25 % were found to harbour *H. taichui*. In this communication the pathological changes caused by the parasite are reported.

The parasites were recovered in large numbers from the small intestine. The anterior portion of the small intestine was slightly inflamed. The mucosa was covered with excessive secretion. The worms were found embedded in the deeper layer of the mucosa. Lesions were more prominent in the duodenum than in the rest of the small intestine. There was a mild hyperaemia of the mucous coat of the small intestine. The histo-pathological examinations revealed the cross-sections of the parasite in the crypt of Lieberkuhn showing pressure atrophy in the neighbouring villi (Fig. 1). The goblet cells lining the villi were either atrophied or had completely disappeared. Infiltration of the lamina propria with large mononuclear cells was also observed. In heterophyid infections in man, Africa *et al.*[1] found marked interstitial and sub-epicardial oedema, intense capillary injection with haemorrhages in the epicardium, fragmentation of muscle fibres and embolism of the vessels. They recovered heterophyid ova in sclerosed mitral valves of human beings who had died of heart failure. They also reported[2,3] that heterophyid parasites penetrated into the deeper layers of the intestinal mucosa and the liberated eggs were caught up in the cardiac vessels. They observed visceral complications in intestinal heterophyidiasis of man.[4] Cameron[6] reported the presence of *Heterophyes heterophyes* in between the villi of a cat, but without any significant lesions in the adjacent tissues.

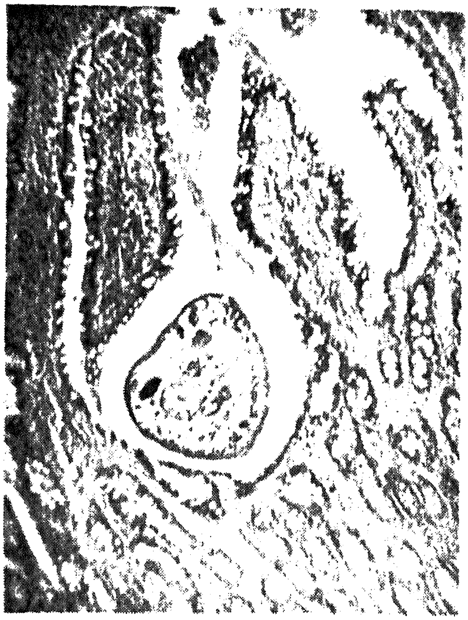


FIG. 1. Section of the intestine showing *H. taichui* in between two villi (× 250).

The author is thankful to Dr. H. D. Srivastava, Indian Veterinary Research Institute, Izatnagar, for guidance and providing laboratory facilities and to the Indian Council of Agricultural Research, New Delhi, for the award of a Senior Research Fellowship.

Dept. of Parasitology, B. N. Sahai
Bihar Veterinary College,
Patna, *February* 24, 1969.

1. Africa, C. M., Garcia, E. Y. and Leon, W. De., *J. Philipp. med. Ass.*, 1935, **15**, 358.
2. —, Leon, W. De. and Garcia, E. Y., *J. Philipp. med. Ass.*, 1936, **15**, 583.
3. —, — and —, *Ibid.*, 1936, **16**, 22.
4. —, — and —, *Internat. 3rd Cong. Microbiol.*, New York, 1940, p. 417.
5. Bhalerao, G. D., *J. Helminth.*, 1936, **14**, 207.
6. Cameron, T. W. M., *The Parasites of Domestic Animals*, 2nd Ed., Adam and Charles Black, London, 1951.
7. Rao, B. V. and Anantaraman, M., *J. Helminth.*, 1967, **41**, 211.
8. Sahai, B. N., *Indian vet. J.*, 1969, **46**, 733.
9. Sahasrabudhe, V. K., Dubey, J. P. and Srivastav, H. O. P., *Indian J. Med. Res.*, 1969, **57**, 56.
10. Sinha, S. S. and Deshpande, P., *J. Osmania University*, 1964, **1**, 53.

OCCURRENCE OF *ARTEMIA SALINA* IN SOUTHERN INDIA

Kulkarni (1953) reported the occurrence of the genus *Artemia* for the first time in India from the salt-pans at Vadala near Bombay. Subsequently, Baid (1958) recorded the species *Artemia salina* from Sambhar Lake in Rajasthan. Recently, during our collection trips, animals belonging to the genus *Artemia* were obtained from the salt-pans at Veppalodai near Tuticorin on the South-Eastern coast of India. The specific identity of the species as *Artemia salina* was determined by Dr. J. P. Harding and Dr. K. G. McKenzie, British Museum (Natural History), London, U.K., to whom the authors extend their gratitude.

The animals occur in large storage lakes as well as in the shallow salt-pans. Water for these lakes and pans is pumped from the bore-wells sunk on the seashore. The highest salinity recorded in these waters is 220‰.

The two earlier records of *Artemia* are from the Western India and the present report on the South-Eastern corner of the country, therefore extends its distribution further to the Peninsular India. It is well known that these branchiopods produce dormant eggs. It is also known that aquatic migratory birds could be the carriers in transporting the eggs and spores from one environment to the other. It may therefore be suggested that probably the eggs of *Artemia* could have been transported by the migratory flamingo (*Phœnicopterus roseus* Pallas) which visit these areas in the South-Eastern part of India from Western India. It is known that the brine shrimp *Artemia salina* is also used as food by the greater flamingo, *Phœnicopterus roseus* (Baker, 1929), among several other food items which probably require further confirmatory studies as suggested by Ali (1964). In the present instance though these birds were seen feeding in these salt-pans, no gut analysis was made to confirm their *Artemia* feeding propensities.

We are very grateful to Prof. S. Krishnaswamy and Dr. R. George Michael, Department of Biological Sciences, Madurai University, for their guidance and help in the preparation of this note. This work was carried out during the tenure of University Studentships to two of us (J. P. R. and A. M. S.) and Government of India R.T.S. Scholarship to the other (P. N.).

Dept. of Biological Sciences, Madurai University, Madurai-2, September 8, 1969.
Joseph P. Royan.
P. Navaneethakrishnan.
A. M. Selvaraj.

---

1. Ali, Humayun Abdul, *Jour. Bombay Nat. Hist. Soc.*, 1964, **61** (1), 60.
2. Baker, E. C., Stuart, *Fauna of British India Including Ceylon and Burma*, Taylor and Francis, London 1929, **6**.
3. Baid, Inderchand, *Curr. Sci.*, 1958, **27** (2), 57.
4. Kulkarni, C. V., *Jour. Bombay Nat. Hist. Soc.*, 1953, **51** (4), 951.

GENUS *BUXBAUMIA* IN INDIA

Buxbaumia is a remarkable bryophyte in its habitat, nutrition, gametophyte and sporophyte characteristics and phylogenetic significance. The plants are rather rare even though they have been reported to occur in Europe,[1-3] America[4,5] and Asia notably from China,[6] Java[6] and Japan.[7] However, there is no report of its occurrence from India.[8] In a recent plant collection trip (last week of September 1969) from this Department the plants were discovered at an altitude of 10,500 ft., growing on decayed wood, on way to Khadamba peak from Deoban in the Western Himalayas. The salient features of this interesting taxon are given below. The collected specimens (Fig. 1) approach *Buxbaumia minakatœ* S. Okam.[7] in certain features.

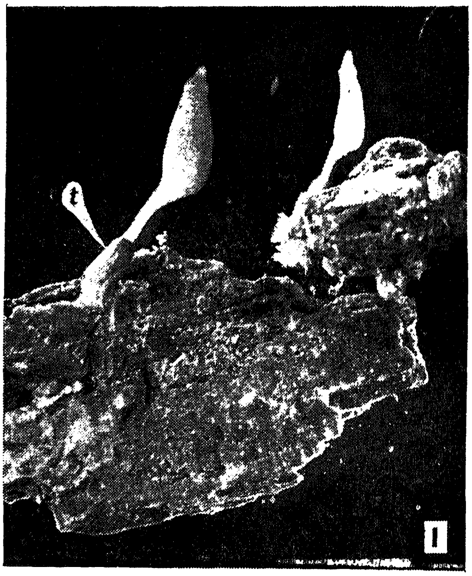


FIG. 1. Plants of *Buxbaumia* on rotten wood (t = tuberous stem apex), × 4 (approximately). (Coll Drs. R. Udar, J. P. Tewari, H. N. Verma and party, September 23, 1969).

Buxbaumia minakatœ has a persistent protonema which branches freely and ramifies the matrix of the rotten wood much in the same way as fungal hyphæ do. The gametophores borne on the protonema are extremely abbreviated and the entire gametophyte has rather poor photosynthetic capability. The male gametophore merely consists of an almost microscopic bract subtending an antheridium which led Goebel[9] to remark about it as 'the simplest moss plant we know'. Even the female gametophore has only some perichætial leaves (vegetative leaves are extremely rare or even absent) which are not visible once the sporophyte is formed. There is thus a strong tendency towards saprophytic nutrition, a highly rare occurrence in the group of autotrophic bryophytes. However, the mature sporophyte (Fig. 1), which is the only part of the plant conspicuously visible, has elaborate development of photosynthetic tissue. The apex of the female gametophore gets transformed into a tuberous structure (Fig. 1, *t*) laden with proteins and oils. The surface of the tuber develops extensively branched rhizoid system which anchors the plant to the substratum. The totally curious and notable structure of the asymmetrical sporophyte, as seen externally, has led to two popular names for the plant: 'A-bug-on a stick' or the 'Hump-backed Elves'.

The peristome structure in *Buxbaumia* is a remarkable feature of phylogenetic interest. It consists of an inner peristome in the shape of a whitish 'pleated' cone which is clearly nematodontous, and an outer peristome of one or several rings of thread-like teeth of the arthrodontous type. *B. minakatœ* has rudimentary and finely papillose outer peristome. The dual nature of the peristome has always defied a convincing placement of *Buxbaumia* in a scheme of moss classification. Perhaps this consideration led Bodenberg[4] to place this plant squarely between nematodontous and arthrodontous families with Buxbaumiaceæ listed twice: in part with the nematodontous families and in part with the arthrodontous families.

The discovery of *Buxbaumia* adds a highly significant taxon to the bryoflora of India.

Department of Botany, RAM UDAR.
Lucknow University, S. C. SRIVASTAVA.
Lucknow, *October* 15, 1969. DINESH KUMAR.

---

1. Dixon, H. N., *The Student's Handbook of British Mosses*, 2nd Ed., Eastbourne, U.K., 1904.
2. Watson, E. V., *The Structure and Life of Bryophytes*, Hutchinson University Library, London, 1964.
3. Brotherus, V. F., in Engler and Prantl, *Die natürlichen Pflanzenfamilien*, I Teil, 3 Abteilung, Leipzig, 1909.
4. Bodenberg, E. T., *Mosses, A New Approach to the Identification of Common Species*, Burgess Publishing Co., Minnesota, U.S.A., 1954.
5. Grout, A. J., *Mosses with Hand-lens and Microscope*, New York City, 1903.
6. Brühl, P., "A census of Indian mosses ..etc.," *Rec. Bot. Surv. of India*, 1931, **13** (1), 1.
7. Iwatsuki, Z. and Sharp, A. J., "The bryogeographical relationships between Eastern Asia and North America—I," *J. Hattori bot. lab.*, 1967, **30**, 152.
8. Wijk, R. V. D., Margadant, W. D. and Florschutz, P. A., *Index Muscorum*, **1**, (A C), 1959, in *Regnum Veg.*, **17**, 1.
9. Goebel, K., *Organography of Plants*, Translated by Bayley-Balfour, Oxford, 1905, **2**.

HISTOLOGY OF ACCESSORY GLANDS OF *NECROSCIA SPARAXES* WESTWOOD (PHASMIDA)

SIEBOLD and Stannius[1] described the genital accessory glands of *Timema californica* in which they consist of numerous tubules of different sizes. In *Leptiniella attenuata*, De Sinety[2] showed a pair of long lateral tubules serving as vesicula seminalis and a group of six median tubules as the accessory glands. Pehani[3] regarded two lateral tubules of the group of accessory glands functioning as the vesicula seminalis in *Carausius morosus*. Gangrade[4] described a pair of accessory glands associated with the ejaculatory duct of *Necroscia sparaxes* in which each gland was composed of three sac-like lobes out of which the middle one was the largest in size, while the other two lobes were more or less equal. The accessory glands were situated so close to the median ejaculatory duct that it was difficult to distinguish the functional significance of the lobes of the glands from their apparent form. For this purpose, the accessory glands of *Necroscia sparaxes* were separated from the male reproductive organs for fixation in the Bouin's fluid and for processing them through the usual procedure for making paraffin blocks for section cutting.

The study of the sections of the lobes of the accessory glands of *N. sparaxes* revealed that the epithelial layer of the median lobes, which were apparently larger in size, was composed of cuboidal cells outlined by the basement membrane. The cuboidal cells contained large nuclei and appeared secretory. A few sperms were also seen in the lobes (Fig. 1, SPM). The anterior and posterior lobes of the accessory glands were devoid of any sperm, though the epithelium of the same was also composed of flat cuboidal cells which were probably concerned with secretion.

It is clear that the median pair of lobes of the accessory glands of *N. sparaxes* were, in fact, a part of the vasa deferentia and not of the accessory glands as reported by Gangrade.[4] As a matter of fact, each median lobe was formed as a diverticulum of the vas deferens of its side and constituted a vesicula seminalis whose function is to store sperm and to provide nutrition to them from their secretions. The remaining anterior and posterior pair of lobes served as true accessory glands which were now bilobed only. The positions of the accessory glands and the vesicula seminalis of *N. sparaxes* were thus found to differ significantly from those found in *Leptiniella attenuata* and *Carausius morosus* described earlier.

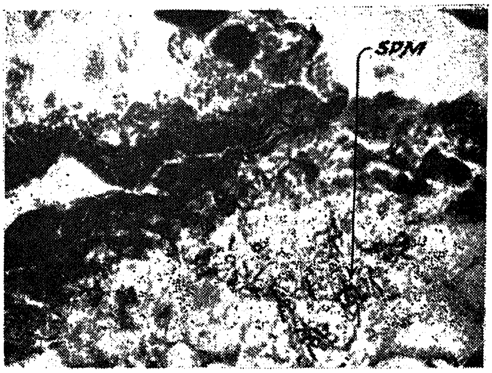


FIG. 1

Jawaharlal Nehru G. A. GANGRADE.
Krishi Vishwa Vidyalaya,
Jabalpur (India), *August* 21, 1969.

---

1. Siebold, C. T. and Stannius, H., *Comparative Anatomy*, Translated with notes and additions by W. I. Burnett. 2 Vols., Boston, 1854.
2. De Sinety, R.. ``Recherches sarla biolgie et Anotomie des phasmes,'' *La Cellule*, 1901, **19**, 117.
3. Pehani, H., *Zeitichr. Wiss. Zool.*, 1925, **125**, 167.
4. Gangrade, G. A., *Indian J. Ent.*, 1963, **25**, 307.

PERITHECIAL STAGE OF *PESTALOTIA OSYRIDIS* THUEM.

DURING a collection tour to Darjeeling in October 1966, the authors isolated *Pestalotia osyridis* Thuem. from the leaf spots of *Berberis insignis* Hook. and Thoms. and *Bucklandia populnea* R.Br. Infection on these leaves was initiated from the margins as circular amphigenous patches of dark-brown colour. The lesions enlarged in size with the advancement of the disease. In case of *Berberis insignis* the infected tissues turned brittle.

Conidial Stage.—Fruiting pustules were conical (Fig. 1), erumpent, 110–145 μ with 3–4 layered thick wall, filled with numerous conidia produced on short conidiophores.

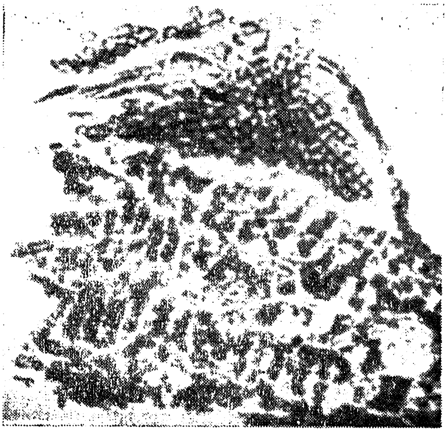


FIG. 1. Photomicrograph showing conical conidial pustule of *Pestalotia osyridis*, × 234.

The conidial morphology of both the isolates was almost identical in culture. Conidia 5-celled, narrow, fusiform, 18·9–27 × 3·24–5·4 μ long; intermediate coloured cells, light-olive, concolorous, 12·15–14·85 μ long; apical hyaline cells, conic, bearing 1 to 3, usually 3 setulæ, 8·1–13·5 μ long, basal hyaline cells acute, tapering into a short pedicel, 2·7–6·21 μ in length.

Perithecial Stage.—The isolate from *Bucklandia populnea* showed frequent development of perithecia in close association with conidial pustules. On the other host, *i.e., Berberis insignis* though the conidial and perithecial stages were not observed under natural condition but on artificial inoculation, the hosts inoculated with conidia developed perithecia also. On the basis of morphological characters the perithecial stage was identified as a species of *Leptosphœria.* The important morphological characters of the perithecial stage were as follows:

Perithecia, pyriform, 144–200 μ; asci 27–59·4 μ long, cylindrical, hyaline, having obliquely arranged ascospores; ascospores 3-celled (Fig. 2), yellowish, fusoid to elliptic, 10·8–16·2 × 5·4–6·21 μ in dimension.

There are a few scattered reports regarding the perithecial stages of *Pestalotia.* Hansen *et al.*[1] obtained in culture the perfect stage of *Pestalotia palmarum* corresponding to genus *Leptosphœria.* Hoenel[2] observed association of *Pestalotia truncata* with *Cerastoma vitis* on

Humulus lupulus. Seaver[3] recognized the perfect stage of *Pestalotia* as *Pestalopezia*. He established close association of *Pestalotia macrotricha* with *Pestalopezia rhododendri*

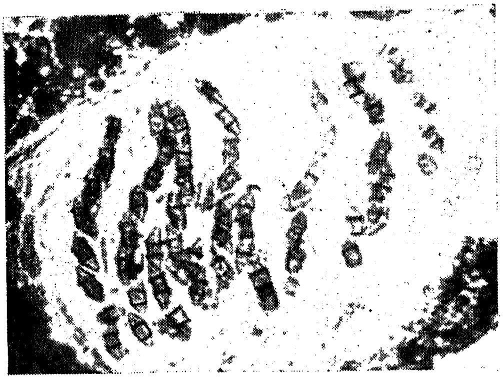


FIG. 2. Photomicrograph showing a perithecium with asci and ascospores, × 480.

Zeller[4] described *Dermatea bruneo-pruinosa* as the ascigerous stage of *Pestalotia gibbosa* on the leaves of *Gaultheria shallon*.

Department of Botany, K. S. Bilgrami.
University of Jodhpur, D. K. Purohit.
Jodhpur, *August* 25, 1969.

---

1. Hansen, H. N., George, A., Zentmyer and Snyder, W. C., *Phytopathology*, **1956**, **46**, **637**.
2. Hoenel, F. Von and Sitzb, K., *Akad. Wiss. Wien. Math. Naturw. Kl.*, 1917, **126**, 348.
3. Seaver, F. J., *Mycologia*, 1942, **34**, 298.
4. Zeller, S. M., *Ibid.*, 1934, **26**, 291.

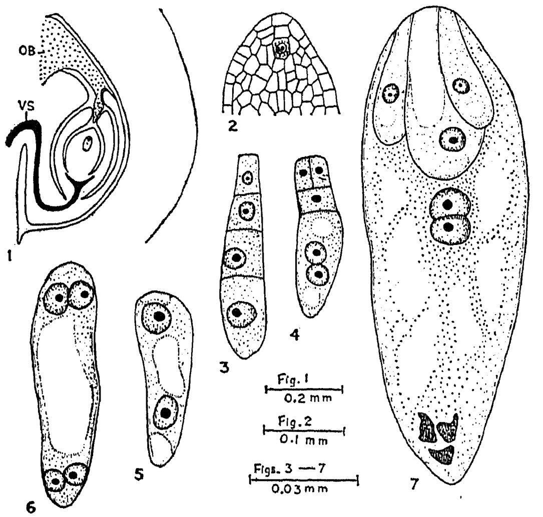
DEVELOPMENT OF FEMALE GAMETOPHYTE IN *SAPIUM SEBIFERUM* ROXB.

The family Euphorbiaceæ is of considerable interest embryologically because of different types of embryo-sac development in its various taxa.[1,2] This communication deals with the development of the female gametophyte in *Sapium*.

Sapium sebiferum is grouped in the sub-tribe Stillingiinæ, tribe Hippomaneæ and subfamily Crotonoideæ.[3] It is a medium-size tree and the plants are either monœcious or sometimes diœcious. Materials both from monœcious and diœcious plants were analysed during the present study.

The ovary is generally tricarpellary (sometimes bicarpellary), syncarpous, trilocular and superior. Each locule encloses a single pendulous, anatropous, bitegminal and crassinucellar ovule attached to the axile placenta. A well-developed obturator is also present above each ovule (Fig. 1). Both the integuments form the micropyle and many cells of the obturator enter into it.

In more than forty ovules only a single deep-seated megaspore mother cell has been seen (Fig. 2). Megaspore mother cell undergoes meiosis and the four megaspores formed are arranged either in a linear or T-shaped manner (Figs. 3 and 4). The megaspore at the chalazal end functions further while the remaining three degenerate. The functional megaspore enlarges and undergoes three mitotic divisions without cytokinesis finally leading to the formation and organisation of the female gametophyte (Figs. 5, 6, 7) whose development thus conforms to the Polygonum type. The embryo-sac is quite large and the egg apparatus consists of two synergids and an egg. The two polars lie close to the egg and the three antipodals are ephemeral. There is no difference in the development and origanisation of the female gametophyte in monœcious or diœcious plants.



FIGS. 1–7. *Sapium sebiferum*. Fig. 1. L.S. ovule at the organized female gametophyte stage. Fig. 2. L.S. ovule showing megaspore mother cell. Figs. 3-4. Linear and T-shaped tetrad respectively. Fig. 5. Binucleate embryo-sac. Fig. 6. Tetranucleate embryo-sac. Fig. 7. Organised embryo-sac. *OB*, obturator; *VS*, vascular supply.

I am thankful to Dr. R. P. Singh for suggestions and to Dr. L. B. Singh, Director, for facilities.

National Botanic Gardens, SUMAN CHOPRA.
Lucknow, *August* 16, 1969.

---

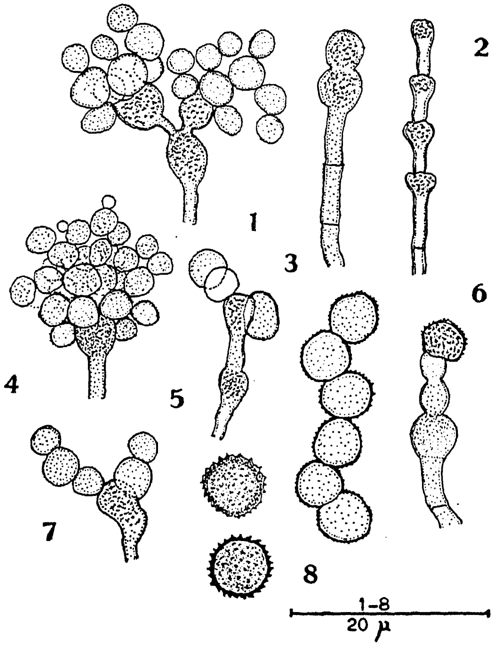
1. Benerji, I. and Dutt, M. K., *Proc. Ind. Acad. Sci.*, 1944, **20 B**, 51.
2. Davis, G. L., *Systematic Embroyology of the Angiosperm*, John Wiley & Sons, Inc., New York, 1966.
3. Pax, F. and Hoffmann, K., "Euphorbiaceæ" in Engler-Prantl's, *Die Natürlichen Flanzenfamilien*, 1931, **2**, 19*c*.

A NEW *HAPLOBASIDION* FROM HYDERABAD

Haplobasidion Eriksson based on the type *H. thalactri* is a dematiaceous form having simple or branched conidiophores with pronounced apical vesicles, producing branched or unbranched acropetal blastospore chains from the sporogenous cells or directly from the vesicles and in the chain spores are separated from one another by short isthmus. The conidia and sporogenous cells on detachment leave scars on the vesicle. The conidiophore proliferates through the scar or vesicle to form another vesicle at a higher level. *Lacellinopsis* Subram., is a close repository which differs from it in having setose colonies. Ellis (1957) gave an excellent account of this and allied forms while Kapoor and Mudjal (1968) described *H. himalayensis* fsom India. In this communication a new *Haplobasidion* is reported, collected during the studies on the Hyphomycetes of Hyderabad.

Haplobasidion indica Sp. Nov.

This beautiful fungus produces brown irregular, effuse colonies on the substratum. Mycelium smooth subhyaline to brown, branched, septate, superficial or partly immersed in the substratum, 3·6–5·4 μ broad. Conidiophores arise singly or in groups from the hyphæ or lateral branches. They are simple, straight or flexuous, smooth ,0-2, septate, subhyaline to brown, 3·6–7·2 μ broad, 14·4–64·8 μ long with swollen vesicular apices, formed by the apical cell, apex is globose to subglobose, dark, rough-walled and the vesicle measures 10·8–14·4 μ across. The proliferations of the conidiophores take place either from the swollen vesicle or annular scar or the invagination formed on detachment of conidia and sporogenous cells (up to 3 apical proliferations were observed). The sporogenous cells are globose to oval, thick-walled, light brown, verrucose 8·6–10·8 μ across and cut off branched or unbranched acropetal chains of blastospores. They are dark brown, thick-walled, spiny to loosely warty, spines hyaline to subhyaline, 7·2–10·8 μ across and the chain measures 18–36 μ long, blastospores connected to each other by very minute isthmus.



FIGS. 1–8. *Haplobasidion indica* sp. nov. (from type material V.V.C.B.L. No. 441). Figs. 1–7. Conidiophores with vesicles, proliferations, sporogenous cells and blastospores. Fig. 8. Matured blastospores.

In having large sporogenous cells, conidia with spiny to warty sporoderm, differs from other species of *Haplobasidion*, hence reported new as *H. indica*.

Collected on dead leaves of *Borassus flabelifer* L., from Hyderabad on 25-11-1966, coll. V.R., V.V.C.B.L. No. 441.

Haplobasidion indica Sp. Nov.

Coloniæ hypophyllæ, brunneæ vel pallide brunneæ, effusæ. Mycelium immersum, ex hyphis ramosis, septatis, hyalinis vel subhyalinis, 3·6–5·4 μ crassis. Conidiophora singula vel fasciculata ex apice lateribusque hypharum, oriunda, erecta vel ascendentia, simplicia, recta vel flexuosa, subhyalinis vel pallide brunneæ, 0-2, septatæ, 3·6–7·2 μ lata, 14·4–68·4 μ longa, cellula apicalis ejus in vesiculum semiglobosam, fusce brunnea, verrucosa 10·8–14·4 μ crassis, superne inflata per usque ad 2–3 proliferationes successivas. Cellulæ sporogenæ, verriculosa, 8·6–10·8 μ diam. Blastosporas vel catenulas simplices vel ramosas disposita gerentes per isthmi. Blastosporas sphærica, pallide brunnea, spinulosa, 7·2–10·8 μ diam.

Thanks are due to Dr. M. B. Ellis, C.M.I., England, for providing literature, to Mr. P. S. Rao, Principal, for facilities and Dr. S. D. Satwalekar, former Principal, Vivek Vardhini College, Hyderabad, for encouragement.

Department of Botany, VASANT RAO.
Vivek Vardhini College, DEV RAO.
Hyderabad (A.P.), India,
February 24, 1969.

---

1. Ellis, M. B., *Mycol. Pap., No. 67*, 1957, p. 1.
2. Kapoor, J. N. and Munjal, R. L., *Ind. Phytopath.*, 1968, **21**, 109.

NEW FACTOR FOR RESISTANCE TO STEM RUST OF WHEAT (*PUCCINIA GRAMINIS, TRITICI* f. sp. ERIKSS AND E. HENN)

STEM rust of wheat is a serious problem in the wheat growing tracts of India adversely affecting yield. The incorporation of resistance to all the twenty-three physiological races of stem rust into commercial wheat varieties is essential for the stabilization of wheat yields. Among physiological races of stem rust of wheat, race 122 is known to be very virulent and also a widely prevalent one. The identification of resistance factors for subsequent incorporation into commercial types is of immediate practical importance. In the course of work at the I.A.R.I., on the identification of new genes conferring resistance to one or the other of the three rusts, about one hundred varieties of wheat, both indigenous and exotic were systematically screened to individual races of rust along with the single gene tester lines having one of the already known Sr. genes. During this work, evidence was obtained of the presence of a new factor for resistance to race 122 of stem rust of wheat.

During January and February of 1968, ninety-eight varieties, comprising of hexaploid ($2n = 42$) and tetraploid ($2n = 28$) wheats, twelve standard stem-rust differentials, five Indian supplementals and nine Marquis backcross lines obtained from Dr. D. R. Knott of Canada were tested to *P. graminis ritici*, race 122 at an average temperature of 72° F. The results indicated that the backcross lines carrying the genes Sr 1, Sr 6, Sr 7, Sr 9*a*, Sr 9*b*, Sr 11, Sr 13, Sr 14 and varieties Norka (Sr 15) and Renown (Sr 17) were ineffective against this race. However, the Marquis backcross line carrying Sr 8 showed "2–2 + " infection type, which suggested that this gene might be effective to race 122. A number of wheat varieties like E. 5008, E. 5016 (both hexaploid) and N.P. 202, Plot 17, Plot 22, Mx 09, Mx 12 and Mx 14 (all tetraploids) showed "2" infection type. However, the selection from the cross (E. 4870 × H. 132–4) F_5 gave a "0" infection type. As each resistance gene is characterised by a specific type of pustule, this would suggest that these selections may carry previously undescribed gene or genes.

This finding is of considerable importance as the incorporation of this gene into commercial wheat varieties would further the cause of reducing damage to wheat yield by stem rust.

We are grateful to Dr. M. S. Swaminathan, Director, I.A.R.I., for guidance, to Dr. H. K. Jain for the facilities given, to Dr. L. M. Joshi for the supply of initial inoculum of race 122 and to Dr. S. Rajaram for suggestion in preparing this note.

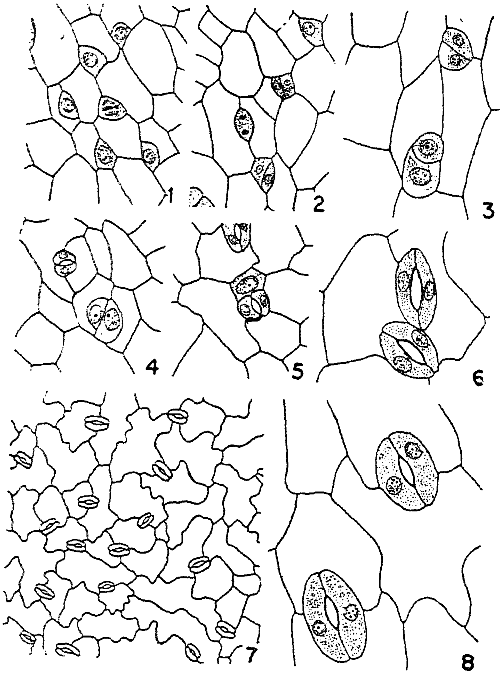
Division of Genetics, V. K. SRINIVASAN.
I.A.R.I., New Delhi, P. S. L. SRIVASTAVA.
August 25, 1969.

ONTOGENY OF STOMATA IN *TRACHYSPERMUM AMMI* (L.) SPRAGUE (*CARUM COPTICUM* CLARKE)

THE members of the Umbelliferæ are not only well-known as a source of food and spices but also for their medicinal value. During recent years they have been employed for morphogenetic studies and have yielded interesting results (*see* Sehgal[1]). As regards the epidermal structure, there are only two publications so far. The first one by Gupta *et al.*[2] describes the morphology and ontogeny of stomata in vegetative as well as reproductive organs of *Bupleurum tenue*. In the second article, Guyot[3] has surveyed 89 species of umbellifers for variations in the stomatal types. The present note deals with stomatal development of *Trachyspermum ammi*, commonly known as 'omum'.

The material for the present study was collected from the plants growing at the Delhi University Botanical Garden. Young leaves were fixed in Farmer's fixative (absolute alcohol 3 : acetic acid 1), the peels were stained with acetocarmine, dehydrated in acetic acid-tertiary butyl alcohol series and mounted in euparal (*see* Paliwal[4]). These preparations were employed for tracing the ontogeny of stomata. For a study of the mature epidermis, peels from fully expanded leaves were stained with Delafield's hæmatoxylin and mounted in glycerine jelly.

The epidermis of young leaves is composed of polygonal cells. Numerous meristemoids, at various stages of stomatal development, are interspersed between the polygonal cells. The meristemoids have a lenticular or trapezoidal shape, a conspicuous nucleus located in cytoplasm with dense, granular contents (Figs. 1, 2).



FIGS. 1–8. *Trachyspermum ammi.* Development of stomata. Figs. 1–6, 8, × 420; Fig. 7, × 245. Figs. 1, 2. Meristemoids at various stages of development. Fig 3. Two pairs of closely placed meristemoids Fig. 4 Two appressed meristemoids cut off from adjacent cells and one young stoma. Figs. 5, 6. Formation of twin stomata. Fig. 7. A portion of the lower epidermis of a fully expanded leaf; note the markedly sinuous anticlinal walls. Fig. 8. Same, portion enlarged.

The stomata follow perigenous mode of ontogeny. The meristemoids are cut off from epidermal cells by an oblique wall. They undergo a vertical division and directly become converted into guard cells. In several instances, however, an additional division takes place prior to the formation of the guard cells (Figs. 3, 4). Thus, two meristemoids become closely placed, and when these divide, twin stomata result (Figs. 5, 6). This situation is also acquired when two meristemoids, cut off from adjacent protodermal cells, become arranged close to each other. Earlier investigators on the members of this family have not observed this feature.[2,3] In some instances, one of the closely placed cells acquires the configuration of subsidiary cells so that the mature stomata tend to appear diacytic or even anisocytic (Fig. 7). Thus, the epidermis of a fully differentiated leaf presents an assemblage of various stomatal types interspersed between cells possessing highly sinuous anticlinal walls (Figs. 7, 8).

We take this opportunity to express our gratitude to Professor B. M. Johri for encouragement and facilities. Thanks are also due to Dr. R. N. Chopra for helpful comments.

Dept. of Botany, C. B. SEHGAL.
University of Delhi, G. S. PALIWAL.
Delhi-7, *August* 22, 1969.

---

1. Sehgal. C. B., *Phytomorphology*, 1968, **18**, 509.
2. Gupta, S C., Paliwal. G. S. and Gupta, Manju, *Inr. Bot.*, 1965 **29** 645.
3. Guyot. M., *Bull. Soc. Bot. Fr.*, 1966, **113**, 244.
4. Paliwal, G. S., *Curr. Sci*, 1967, **36**, 191.

RACES OF BACTERIAL BLIGHT OF COTTON [*XANTHOMONAS MALVACEARUM* (E. F. SMITH) DOWSON]

A KNOWLEDGE of the occurrence and identification of races is basic to a sound programme of breeding resistant varieties. Physiologic races may differ in some of their biochemical properties or susceptibility to phages but generally they are established on the basis of a more or less stable pathogenic reaction (host-parasite interaction) on a definite set of hosts (differentials). Nayudu (1964) used the susceptibility of 1 or more of the 4 cultivated species of *Gossypium* to characterise four races (A, B, C and D). Hunter, Brinkerhoff and Bird (1968) suggested the use of differentials of similar genetic background that primarily differ in blight-resistant genes to identify the races and on the basis of the reaction of isolates on eight selected varieties of upland cottons (*G. hirsutum*) they identified fifteen races, which were numbered as 1 to 15.

We have used the method of inoculation of Hunter *et al.* Plants with 6–8 true leaves were inoculated by a suspension of the bacterial isolate (O.D. = 0·1) at 10 lb. pressure onto the lower surface when the stomata were open. We have used the differentials of Hunter *et al.* as well as that of Nayudu and are, therefore, in a position to assess the suitability of both in testing races of *X. malvacearum*.

By using the differentials of Hunter *et al.*, we could definitely identify the occurrence of races 3 (at Raya), 10 (at Raya, Delhi, Sirsa, Jetser, Ludhiana and Jullundur) and 14 (at

Delhi, Jullundur and Bullandshahar). Further, two new types of reaction were obtained —one from Delhi and another from Bullandshahar isolate. The Delhi isolate was pathogenic on Acala 44, Stoneville 2B-S9, Stoneville 20, 20-3 and Mebane B-1. The Bullandshahar isolate also gave a similar reaction but was non-pathogenic on Mebane B-1. These isolates have been provisionally named as I_1 and I_2 respectively.

By using Nayudu's system, we have found that a few isolates are pathogenic only on *G. hirsutum*. These will be a new race which we would like to name E in continuation to the nomenclature of Nayudu. The occurrence of other new races, in accordance to this system, will be demonstrated in the coming years with the intensification of study of races.

In the dilemma of finding out a suitable procedure for race and biotype identification we think that the procedure of Hunter *et al.* may be more useful. But we believe that races are more distinct taxon than biotypes. Therefore, the races may be tested (following Nayudu) on differentials including all the 4 species of cultivated *Gossypium*. The biotypes can be tested (following Hunter *et al.*) on a second set of differentials of one species with similar genetic background.

The authors are grateful to Prof. S. P. Raychaudhuri for his keen interest and advice throughout the work. We are obliged to Dr. Charles F. Lewis, Leader, Cotton Genetics and Breeding Investigations, Beltsville, Maryland, U.S.A., and Dr. V. Santhanam, Project Co-ordinator (Cotton), for sending the seeds of the differentials use by us.

Division of Mycology and Plant Pathology, J. P. VERMA.
Indian Agricultural Research Institute, R. P. SINGH.
New Delhi (India), *September* 5, 1969.

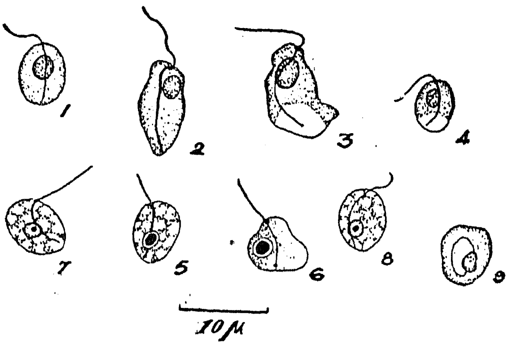
1. Hunter, R. E., Brinkerhoff, L. A. and Bird, L. S., *Phytopathology*, 1968, **58**, 830.
2. Nayudu, M. V., *Indian Cotton Growing Rev.*, 1964, **18**, 250.

RHIZOMASTIX GRYLLOTALPAE N. SP. FROM *GRYLLOTALPA AFRICANA*

THE investigation of the intestinal protozoans of Indian insects of Hyderabad revealed an interesting flagellate belonging to the genus *Rhizomastix* Alexeieff (1911). The infection was very heavy and found in almost all *Gryllotalpa africana*. The present species is the fourth record of the genus. The parasite is typically oval or round in shape in living condition and it is retained even in stained preparations. The organelle of the body comprises of a blepharoplast, a flagellum, a rhizostyle and a nucleus.

The organism has a well-developed periplast with many cytoplasmic granules. But a few have a clear space at the posterior end of the body (Figs. 3 and 4). The body of the parasite measures (5·0 to 11·0 μ)) 7·58 μ × (4·5 to 8·0 μ) 6·75 μ in average. There is a large and almost round-shaped nucleus, variably situated in the body. It has a large or small endosome (Figs. 5 and 6). In a few, where the endosome is small, it is surrounded by extra-chromatin granules (Figs. 7 and 8).

The flagellum is thick but short, and is continued backward with a rhizostyle, which extends posteriorly beyond the nucleus. It either passes above or by the side of the nucleus (Figs. 1, 3 and 4). In some individuals, a small granule is found at the posterior end of the rhizostyle (Figs. 5 and 6). The flagellum measures 7·78 μ in average, while the rhizostyle 7·50 μ in average. Cystic forms are also noticed **(Fig. 9)**.



FIGS. 1 9. *Rizomastix gryllotalpæ* n. sp. Figs. 1–4. Oval form with a round nucleus, rhizostyle passing above the nucleus. Figs. 2 3. Elongated forms. Figs. 7–8. From with central endosome surrounded by granules. Figs. 5–6. From with large endosome in the nucleus. Fig. 9. Cystic form. (*Figs* 1–3 and 8 drawn from the material fixed in methyl alcohol, stained with Giemsa's; *Figs.* 4–7 from material fixed in Schaudinn's and stained with iron hæmatoxylin.)

In literature, three species of this genus are recorded *Rhizomastix gracilis* Alexeieff (1911), *R. periplanetæ* Rao (1963), *R. rauæ* Murthy (1969). *R. gracilis* differs from the present species in having a long flagellum, about 3 times the body length; a nucleus with an endosome connected by lenin strands; and measures (3·7 to 10·0 μ) 7·5 μ × (2·0 to 4·0 μ) 2·5 μ. *R. periplanetæ* is dimorphic; a thick rhizostyle occasionally forming a loop around the nucleus; free flagellum 4 times as long as the body; nucleus with an endosome; and measures (5·5 to 15·5 μ) 9·6 μ × (5·0 to 7·5 μ) 7·3 μ. All these characters show marked differences with the present species. *R. ranæ* is different from the new species in length of the flagellum, nature of the nucleus and measures 11·67 μ × 6·89 μ.

In view of these differences, the parasite under discussion is considered to be new to science and is designated *Rhizomastix gryllotalpæ* n. sp. after the generic name of the insect.

I am grateful to Professor S. S. Qadri for his guidance and help during the course of my research programme and to Professor S. N. Singh for the encouragement and laboratory facilities.

Department of Zoology,
Post-Graduate Centre,
(Osmania University),
Warangal-1, A.P. (India),
November 17, 1969.

T. BHASKAR RAO.

---

1. Alexeieff, A., *Arch. Zool. Exp.*, 1911, **6**, 491.
2. Bhaskar Rao, T., *Rivista di Parassitologia*, 1963, **25**, 159.
3. Krishnamurthy, R., *Marathwada University Journal of Science*, **8**, p. 133.

CYTOLOGY OF THE HYBRID *SOLANUM INDICUM* L. × *S. MELONGENA* VAR. *INSANUM* PRAIN

HYBRID sterility has been reported on interspecific crosses among the non-tuberiferous *Solanum* species.[2,3] In the present study, a cross was made between *S. indicum* $(2n = 24)$ and *S. melongena* var. *insanum* $(2n = 24)$, mainly to study the sterility aspect.

The crossing was easily effected, taking *S. indicum* as the female parent; the reciprocal cross completely failed. Similar results were reported by Narasimha Rao.[1] The F_1 hybrid was vigorous, but showed partial sterility. It produced a few small fruits under open pollination; however, it failed to set fruit on selfing. It contained 51·3% stainable pollen. Out of these, only 2% were found to be viable in artificial sugar-agar medium. The few which germinated produced extremely short pollen tubes (Table I). It appears that some of the stainable pollen in the hybrid may be, in fact, non-functional.

Meiotic behaviour of the parents as well as the F_1 hybrid was normal. At diakinesis in the F_1, 12 closely-paired bivalents were observed. The chiasma frequency at this stage showed no deviation from those of the parents. The mean chiasmata per bivalent was 1·61 in the F_1, as against 1·62 and 1·72 in the parents. At metaphase I also, 12 bivalents were observed and there was regular orientation at the equatorial plate. At anaphase I, there was equal and normal separation of the chromosomes. Subsequent stages also revealed no abnormalities.

TABLE I

Pollen characters of the F_1 and the parents

Material	Stainable pollen (per cent)	Germination in 10% sugar-agar medium (per cent)	Mean pollen tube length (microns)
S. indicum ..	96·6	52·3	338
S. melongena var. *insanum*	96·8	56·6	287
F_1 (*S. indicum* × *S. melongena* var. *insanum*)	51·3	2·0	40

The chromosome pairing in the hybrid indicates close affinity between the parent species. Yet, the hybrid between them is sterile in spite of regular meiosis. Similar finding has been reported in other genera.[4] In the F_1 hybrid, *S. melongena* × *S. gilo*, Nasrallah and Hopp[2] found that although meiosis and pairing were regular, there was sterility due to irregular distribution of chromosomes and inversion bridges at anaphase. Genic differences between the species or structural hybridity are the probable causes of hybrid sterility in the present case. If structural hybridity exists, it would be of cryptic type due to minute chromosome arrangements.[5]

The author is grateful to Dr. C. N. Sambandam for his guidance and encouragement.

Faculty of Agriculture,
Annamalai University,
August 28, 1969.

S. RAJASEKARAN.

---

1. Narasimha Rao, N., *Madras Agric. J.*, 1968, **55**, 146.
2. Nasrallah, M. E. and Hopp, R. J., *Proc. Amer. Soc. Hort. Sci.*, 1963, **83**, 571
3. Sarvayya, J., *Madras Agric. J.*, 1936, **24**, 139.
4. Sax, K., *Bot. Rev.*, 1935, **1**, 100.
5. Stebbins, G. L., *Variation and Evolution in Plants* Columbia Univ. Press, New York, U.S.A. 195

REVIEWS AND NOTICES OF BOOKS

Enamines : Synthesis, Structure and Reactions. Edited by A. Gilbert Cook. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y.), 1969. Pp. xi + 515. Price $ 35.75.

The explosive growth of enamine chemistry has made it difficult to maintain a coherent view of the field's progress. The rapid expansion of the literature requires, for the first time, an in-depth study of enamine chemistry. In an orderly fashion, this book correlates enamine literature and reviews in detail its synthetic and mechanistic studies as well as its physical properties. Each of the eight chapters of the book presents a different perspective of the field. Fresh insights and differing viewpoints were encouraged to stimulate further research into unexplored areas.

The titles of the chapters contained in this book are : Structure and Physical Properties of Enamines, by Sudarshan K. Malhotra ; Methods and Mechanisms of Enamine Formation, by LeRoy W. Haynes ; Hydrolysis of Enamines, by E. J. Stamhuis ; Electrophilic Substitutions and Additions to Enamines, by G. H. Alt ; Nucleophilic Addition to Iminium Salts, by Joseph V. Paukstelis ; Cycloaddition Reactions of Enamines, by A. G. Cook ; Heterocyclic Enamines, by Otakar Cervinka ; and Enamines in Organic Synthesis, by Martin E. Kuehne.

This book will be found useful by teachers of organic chemistry, graduate students in advanced organic chemistry courses, practising organic chemists who find enamines useful intermediates, natural product chemists, physical organic chemists, and those chemists involved directly in enamine research.

C. V. R.

Techniques and Methods of Organic and Organometallic Chemistry (Vol. 1). Edited by Donald B. Denney. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y.), 1969. Pp. x + 232. Price $ 11.75.

The rapid growth of organic and organometallic chemistry has resulted in a phenomenal expansion of the literature. As a result, the ever-increasing amount of information makes it more difficult for the scientist to keep abreast of developments.

It is the aim of this series to provide a source of specialized reviews on timely topics in organic and organometallic chemistry. Some of the chapters will be of new developments while other reviews will concentrate on established methods and techniques where recent advances warrant new coverage.

The titles of the chapters contained in this volume are listed below : Ozonolysis of Organic Compounds, by Robert W. Murray ; High-Vacuum Techniques, by Arthur C. Bond ; Applications of Fused Salts in Organic Chemistry, by John E. Gordon ; and Non-Aqueous Titrations for Organic Analysis, by C. A. Streuli.

Organic and organometallic chemists as well as inorganic chemists will find the series useful. Students preparing for a career in research in industry, research institutes, and universities should find the timely topics helpful in planning their careers.

C. V. R.

Gas Dynamics. By Ali Bulent Cambel and Burgess H. Jennings. (Dover Publications, Inc., 180, Varick Street, New York), 1969. Pp. xiii + 451. Price $ 3.50.

Now published as a single volume with the 36-page solutions manual, this book provides a foundation in the theory and concepts of compressible-fluid flow and combustion. The subject-matter is particularly pertinent to the internal-flow problems of jet engines to rocket motors, to missiles, to gas turbines, and to other compressible-flow machinery. The book's usefulness, therefore, is broad and growing.

The book covers topics on : Basic Concepts of Gas Dynamics and Gas Properties, Fundamental Equations of Steady Flow, Isentropic Flow, Diabatic Flow, Flow with Friction, Wave Phenomena, Variable-Area Flow, Thermochemistry, An Introduction to Flames and Combustion, An Introduction to Multidimensional Flow, Dimensional Analysis and Similitude, Experimental Techniques and Measurements, and Aerothermochemistry. Twenty-nine worked examples serve as a model for the 183 problems given at chapter ends. Full solutions to all of the problems are supplied in the manual.

Concise and physical, rather than mathematical in approach, the book requires some knowledge of thermodynamics, fluid mechanics, combustion and advanced calculus. Clearly written, it is invaluable for self-study or as a reference. C. V. R.

Fluorine Chemistry Reviews (Vol. 3). Edited by Paul Tarrant. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y.), 1969. Pp. vi + 154. Price $ 12.50.

Increasing study of the fluorine atom has led to new and important developments in polymer and elastomer chemistry. *Fluorine Chemistry Reviews*, an international publication concerned with the theoretical and practical aspects of fluorine chemistry, provides information of current research in this rapidly expanding field.

The papers published here cover historical background and recent developments. The authors are internationally known fluorine chemists who are making significant contributions to their special fields. This book will be found useful by all researchers interested in the fast-growing field of fluorine chemistry.

Volume 3 contains the following chapters: Fluorine Compounds in Anesthesiology, by Eric R. Larsen; Reactions of Fluoroolefins with Electrophilic Reagents, by B. L. Dyatkin, E. P. Mochalina and I. L. Knunyants; Fluoroalicyclic Derivatives of Metals and Metalloids, by W. R. Cullen; and Phosphorus, Arsenic, and Antimony Pentafluorophenyl Compounds, by Manfred Fild and Oskar Glemser.

C. V. R.

Annual Review of Plant Physiology (Vol. 20). Edited by Leonard Machlis. (Annual Reviews, Inc., 4139 El Camino Way, Palo Alto, California 94306, U.S.A.), 1969. Pp. vii + 689. Price: U.S.A. $ 8.50; Foreign $ 9.00.

The subject-matter in this volume under review has been dealt with under the following headings: 1. Prefatory Chapter on "Resistance to Knowledge", by Hans Gaffron; Cell Structure and Function; Mineral Nutrition; Nitrogen Metabolism; Photosynthesis; General Metabolism; Water Relations; Absorption and Translocation; Growth and Development; Stress Physiology and Special Topics on: 1. Physiology of Rapid Movements in Higher Plants, by Takao Sibaoka; The Role of Plants in the Bioregenerative Systems, by A. A. Nichiporovich; Hormones and Nucleic Acid Metabolism, by Joe L. Key; Permeability of the Plant Cell, by Ed. J. Stadelmann; and Metabolism of Organic Pesticide Chemicals in Higher Plants, by John E. Casida and Louis Lykken. C. V. R.

The Development of Chemical Principles. By C. H. Langford and R. A. Beebe. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W. 1), 1969. Pp. 384. Price 52 *sh.*

This is a well-conceived introductory book on the development of structural principles in chemistry. The authors bring out in a coherent way three lines of the development of contemporary chemical structural theory, starting from early ideas. They are the classical theory of bonding in molecules; the ionic interpretation of electrolyte solutions; and the physical theory of atomic structure.

The first chapter reviews the foundations of atomic-molecular theory and stoichiometry. The next two chapters show how isomer relationships and reaction patterns lead to representation of molecules by geometrical diagrams with bond lines. Chapters 4 and 5 explore the properties of solutions and the concept of ion. Energetic relations and Nernst equation are introduced in Chapter 6. The final three chapters deal with the atomic structure, the periodic law and the electronic theory of valence.

This well-planned and well-illustrated book will be useful for a first year undergraduate course in general chemistry. A. S. G.

A Programmed Course in Algebra. By A. C. Mewborn. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W.1, England). Pp. 630. Price 43 *sh.*

This course, in mimeographed paperback, is programmed for self-instruction. It consists of short sections of text interspersed with questions to be answered by the reader. Author's answers are also given for verification. Instructions about how to use the programme are given in the beginning. With a regular schedule of about one hour a day, the course can be covered in about hundred hours. A. S. G.

Books Received

Principles of Dispersal in Higher Plants. By L. Van der Pijl. (Springer Verlag, Berlin-33), 1969. Pp. vii + 153. MD. 36, U.S. $ 9.00.

Science in India. By A. K. Biswas. (K. L. Mukhopadhyay, Calcutta-12), 1969. Pp. ix + 154. Price Rs. 16·00.

1701–69. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

THE RED OLEANDER AND THE PURPLE PETREA

SIR C. V. RAMAN

THE oleanders, known botanically as *Nerium* and classed in the group *Apocynaceæ*, are flowering shrubs which no Indian garden is without. They are graceful, large, spreading bushes growing to a height of three metres or more, with a number of cane-like stems starting from the ground and bearing narrow evergreen, lanceolate leaves. The shrubs grow to perfection in sunny situations and in sandy or stony soils. The flowers are produced very freely throughout the year in great profusion in large terminal clusters. There are several varieties, with single or double flowers, which may be pure white, or exhibit colours ranging from pink to a deep red or crimson.

Viewing the red oleander held in a bright light through a pocket spectroscope and comparing the spectrum with that of the light diffused by a sheet of white paper, it is seen that the wavelengths greater than 600 mμ do not suffer any loss of intensity. There is a very marked absorption of the region of wavelengths between 500 mμ and 600 mμ, in other words of the green and yellow sectors of the spectrum. Wavelengths less than 500 mμ continue to be visible, though with noticeably reduced intensity. The colour is readily extracted from the flower petals by immersing them in acetone, followed by vigorous shaking. Placing the acetone extract in a five-centimetre long column, and viewing a bright source of light through it, the absorption spectrum exhibits the features which may be expected to be observed in these circumstances. A maximum of absorption in the green is clearly seen as a darker band at about 540 mμ, superposed on a general absorption extending on either side of it. This covers the yellow of the spectrum upto 600 mμ, beyond which the red region is seen with undiminished intensity.

A spectrophotometric record of the absorption by a rather dilute acetone extract from a red Oleander is reproduced as Fig. 1. Three features marked with the respective wavelengths in angstrom units, *viz.*, 5010, 5320 and 5620 are seen in the record. These appear in the same positions as those observed in the acetone extract from a red rose reproduced as Fig. 1 on page 504 of the issue of *Current Science* for November 5, 1969. It is evident that the origin of the red colour of the Oleander is the same as that of red rose, *viz.*, the presence of Florachrome B in the petals of the flower in each case,

Petrea volubilis belongs to the botanical order *Verbenaceæ*. It is a shrub which can be described as a woody vine with a grey bark and characterised by stiff and rough leaves of some size. Being a strong climber, the plant will attain great height and cover a considerable area if left unpruned. It bears bluish-purple five-petalled stars in long elegant wreath-like sprays and hence has been given the popular name of purple wreath. Racemes of these stars, some fifteen or twenty centimetres in length, crowd the plant in the flowering seasons, covering it up in a mass of colour. Given a support of adequate size on which it can climb and establish itself, the plant then makes an impressive show. The five-petalled stars which might be mistaken as flowers are actually only the calices which remain after the true flowers have fallen off. The latter are much smaller and have five petals of a deeper colour. They may be seen resting in two or three of the end calices. One of the five petals in each flower carries a white splash in the middle.

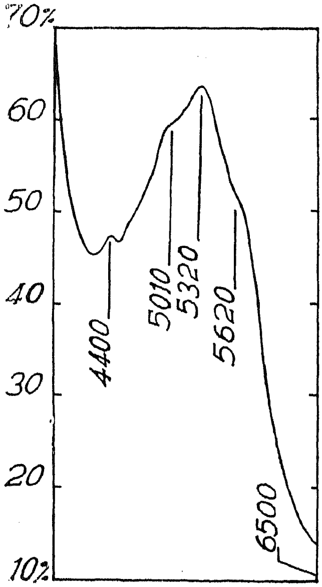


FIG. 1. Absorption by acetone extract of red Oleander

Examined *in vivo* through a pocket spectroscope, the five-petalled stars exhibit a spectrum in which the most noticeable feature is the nearly complete extinction of the yellow region of the spectrum, accompanied by a noticeable reduction of the intensity of the green sector. The blue region of the spectrum, on the other hand, appears without any great diminution of brightness. The red end of the spectrum is also seen with nearly its normal intensity. On account of their small size, the spectroscopic examination *in vivo* of the true flowers is somewhat difficult. But they appear to exhibit the same features as the calices, but in a more accentuated degree.

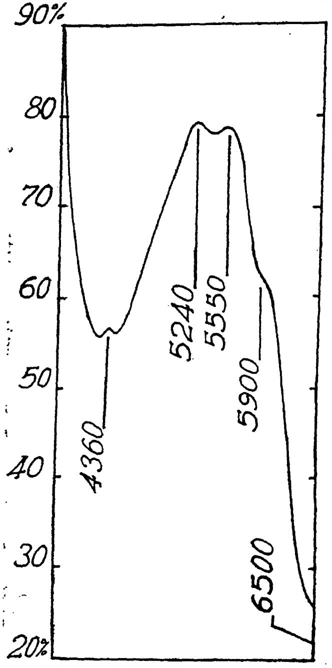


FIG. 2. Absorption by acetone extract of purple Petrea

The material which is responsible for the colour exhibited by the calices of *Petrea volubilis* is readily extracted by shaking them in a glass-beaker with acetone. The absorption spectrum exhibited by a column of the extract of one-centimetre depth is reproduced as Fig. 2. It exhibits features which are very similar to those observed in the spectrophotometer records obtained with the acetone extracts of the purple flowers of *Lagerstrœmia indica* and of the purple verbena, which were reproduced in earlier issues of *Current Science.* These records illustrate the immensely important role played by the yellow sector of the visible spectrum in the perception of light and colour. The absorbing material may be identified as Florachrome B, with a possible admixture of Florachrome A. The presence of the latter would serve to intensify the bluish-purple colour actually observed.

THE INDIAN ACADEMY OF SCIENCES: XXXV ANNUAL MEETING

THE Thirty-fifth Annual Meeting of the Indian Academy of Sciences was held on the 20th, 21st and 22nd December, 1969 at Aurangabad under the auspices of the Marathwada University. The inaugural function and the public lectures were held in the Mahatma Gandhi Auditorium of the Medical College, while the scientific meetings were held in the lecture hall of the Physics Department of the University.

Professor T. S. Sadasivan, Vice-President of the Academy, presided over the inaugural function. Dr. N. R. Tawde, Vice-Chancellor of the Marathwada University and Chairman of the Reception Committee, gave the welcome address.

Professor M. G. K. Menon, Director of the Tata Institute of Fundamental Research, Bombay, delivered the inaugural address on "The Elementary Particles of Physics".

At the scientific meeting in Section A, held in two sessions on the 21st December, and presided over by Prof. M. G. K. Menon, the following papers were presented and discussed: (1) "Structure of the Magnetosphere" by Dr. K. S. Viswanathan, National Aeronautical Laboratory, Bangalore; (2) "Astrophysical Aspects of Modern Cosmic-Ray Studies" by Prof. Yash Pal, Tata Institute of Fundamental Research, Bombay; (3) "Aspects of Computer Sciences and Technology" by Prof. R. Narasimhan, Tata Institute of Fundamental Research, Bombay-5; (4) "Molecular Structure and Nuclear Magnetic Resonance" by Prof. P. T. Narasimhan, Department of Chemistry, Indian Institute of Technology, Kanpur; (5) "Electronic Interpretation of Organic Reactions" by Dr. S. Ranganathan, Department of Chemistry, Indian Institute of Technology, Kanpur; (6) "ESR Investigations on Radiation Induced Electrons and Their Reaction with Biomolecules" by Dr. B. B. Singh, Biology Group and Medical Division, Bhabha Atomic Research Centre, Bombay-85.

The scientific meeting in Section B was held on the 22nd December in two sessions. Presiding over this meeting Prof. T. S. Sadasivan, Director, Centre of Advanced Studies in

Mycology and Plant Pathology, University of Madras, gave an address on "Immunoserology in Plant Pathology". The following papers were presented and discussed: (1) Electron Microscopy and Ultrastructure" by Prof. C. V. Subramanian, University of Madras; (2) "Tea: Clonal Selection and Propagation" by Dr. K. S. Venkataramani, Director, United Planters' Association of South India; (3) "Distribution of Oxygen in the Arabian Sea" and (4) "On the Occurrence of Oxygen Maxima and Minima in the Upper 500 Metres of the North-Western Indian Ocean" by Dr. R. Jayaraman, National Institute of Oceanography; (5) "The Acetylcholine-Atropine Antagonism as Determined by a Series of pA Values" by Dr. M. B. Gharpure, Medical College, Aurangabad.

Two public lectures were delivered, the first on the 21st evening by Dr. S. Bhagavantam on "Electronics and Its Applications" and the second on the 22nd evening by Dr. M. S. Swaminathan, Director, Indian Agricultural Research Institute, New Delhi, on "Genetic Harvest of Our Biological Resources".

ABSTRACTS OF PAPERS PRESENTED AT THE XXXV ANNUAL MEETING OF THE INDIAN ACADEMY OF SCIENCES AT AURANGABAD, MARATHWADA UNIVERSITY, DECEMBER 20-22, 1969

Immunoserology in Plant Pathology

T. S. SADASIVAN
University Botany Laboratory, Madras

Although serology has played a notable part in bacteriology and virology, it has hardly been applied to the same extent in determining specificity in fungal pathogenic forms. Common antigens between host and parasite as a factor in resistance or susceptibility seems to be the objective to be achieved. In other words, disparity between the antigens constituting a resistance factor has to be explored in much detail as it constitutes an area in which much can be understood in host-parasite interactions.

The concept that response of the host towards immunity could be selective and have a bearing on fitness to survive of many parasitic species has had support in both animal and plant diseases. It has been shown, for instance, that the parasitic worm *Hœmonchus contortus* displayed less antigenic disparity towards sheep which is its natural host than with rabbit. None of the larval antisera derived from sheep reacted with adult worm antigenic fractions and also none of the antisera from adult worms derived from sheep showed reaction with antigens from larvæ. Therefore, the lack of response of sheep to antigens common to adult and larval forms seemed to indicate that these antigens were also common to sheep and perhaps constitute "fitness characters". Turning to *Salmonella typhimurium* which had greater susceptibility in mice to infection as compared to rats, susceptibility was ascribed to inability of the susceptible host to produce 'anti-factors' against antigens of the parasite. The common antigen concept has been extended to animal viruses: turkeys resistant to Rous 1 virus could be made susceptible by treating in the embryonic stage with red blood cells of the chicken which is its natural host and, indeed, antigenic similarity between Rous 1 virus and the red blood cells of chicken has been established.

There is no certain evidence, of the type of immune responses mentioned above in plants infected by bacteria, fungi or viruses. However, the formation of abnormal substances in plants under pathogenesis has been shown in many diseases. Dealing with rusts, specific antigens in each of four races of *Melampsora lini* was shown to be shared by only those lines of flax that were susceptible to a particular race. Conversely, a race of rust was avirulent to flax lines that lacked the specific antigen. In these tests four lines of flax that differed from each other in a gene-controlling reaction to the rust were used. Study of antigens of cotton (*Gossypium hirsutum*) and *Xanthomonas malvacearum* showed that host specificity could be immunological in reaction. Similarly, host specificity has been noticed in sweet potato (*Ipomœa batatas*) against *Ceratocystis fimbriata* isolates which produces the black rot disease. These experiments with *C. fimbriata* indicated that an immune response may operate in plants and that a bridge between common antigens in a host and a parasite may provide a less hostile environment to the pathogen.

In plant viruses serology has mostly indicated group specificity and has aided in indicating common antigenic determinants pointing to grouping serotypes and strains. One such recent example is that the Indian legume virus isolate Dolichos enation mosaic virus (DEMV) and the NDEMV strain which infects French beans (*Phaseolus vulgaris*) are serotypes of tobacco mosaic virus (TMV) as it is only remotely related serologically. However, DEMV and NDEMV produce a large proportion of virus particles shorter than 3000 Å which is the accepted length of TMV.

Our own work with strains of the cotton wilt pathogen *Fusarium vasinfectum* and the rice blast fungus *Pyricularia oryzœ* has brought interesting results. An American strain of *Fusarium vasinfectum* pathogenic to *Gossypium hirsutum* and an Indian strain pathogenic to *G. arboreum* were serologically identical. An Indian strain which had lost its pathogenicity lacked an antigen common to the two virulent strains but had an additional antigen. The host specificity of the two virulent strains could not, however, be explained on the basis of antigenic comparison. In *Pyricularia oryzœ* three of the four cultures (P1, A1, M1 and M2) were mutants. The virulent cultures P1 and A1 differed in their growth factor requirements, but were serologically identical. The avirulent cultures M1 and M2, although similar in their growth factor requirements to P1, showed differences in some of the antigenic constituents. However, both avirulent strains shared an additional antigen not present in the virulent ones. The avirulent M2 showed an extra specific antigen. Thus genetic differences between virulent and avirulent strains of *P. oryzœ* seem to be expressed in the protein synthesized by the fungi. Our results seem to point out to the fact that in both *F. vasinfectum* and *P. oryzœ* virulence and avirulence are reflected in antigenicity. However, differences in host specificity in the case of *F. vasinfectum* and nutritional requirements in *P. oryzœ* were not correlatable serologically.

Aspects of Computer Science and Technology

R. NARASIMHAN

T.I.F.R., Bombay-5

In this paper the problem of processing visually given data with the help of computers is considered in some depth. This is an application area of considerable practical importance. It is also of fundamental significance to behavioural studies. Thus, there could be two motivations for studying picture processing with the aid of computers. The first relates to our desire to use computers in much the same way as we use human technicians to process pictures in a variety of situations that arise in science and technology. The second motivation relates to our desire to use computers as simulation tools to imitate human perceptual and cognitive behaviour in relevant ways so as to enable us to construct testable theories. A specific computational approach to picture processing, called the descriptive approach, is developed in some detail. Recent work in this area is discussed. Several computer generated outputs using this approach are presented and their relevance to visual behaviour theory-construction is considered.

Electron Microscopy and Ultrastructure

C. V. SUBRAMANIAN

Centre of Advanced Studies, Madras University

The development of the electron microscope and the remarkable improvement in techniques that have made possible the application of electron microscopy an extremely useful tool in studies on cell biology have been primarily responsible for some of the major breakthroughs in the biological sciences in recent years. It is hardly possible to cover in a single talk the many significant observations on ultrastructure that have been made by the technique of electron microscopy. Consideration is, therefore, limited to some problems of development and morphogenesis in certain fungi, *viz.*, the fungi imperfecti in which I have been interested for several years and in the elucidation of which electron microscopy has been and will continue to be indispensable.

Understanding of conidial ontogeny in the fungi imperfecti is basic to a proper analysis of conidial types, and current emphasis on conidial types and conidiophore behaviour as taxonomic criteria, therefore, imparts a special significance to critical studies on conidial ontogeny. A variety of conidial types are recognized by various authors, but the basic types seem to be only a few. Five conidial types (blastospore, gangliospore, porospore, phialospore, and arthrospore) were recognized by me (1965), based on studies with the ordinary light microscope. Observations with the ordinary light microscope alone are, however, inadequate for the purpose, and the more significant points emerging from recent studies at the ultrastructural level using both the transmission and scanning electron microscopes are summarized. Some analogies between sporogenesis and spore germination, especially in regard to relationship of walls or wall layers, are mentioned. A correct appraisal of the fine structure of cell walls/wall layers of conidiogenous cells and conidia, and of the structural continuity or discontinuity of wall layers or walls between spores and spore mother cells, is the key for a proper definition of spore or conidial types. Continuity or discontinuity of walls or wall layers may be linked up with identity or differences in chemical composition, ultrastructural features and physical properties. Several techniques other than electron microscopy have necessarily to be used as further adjuncts to it and these are aimed at elucidation of the biochemical bases of morphogenesis in fungi through a better understanding of cell wall properties, cell wall composition, cell wall metabolism, cell wall differentiation, cell wall plasticizing and cell wall splitting enzymes, all of which are equally relevant to problems of morphogenesis of conidia. The impact of studies on ultrastructure on the interpretation and recognition of conidial types is discussed and the need for further intensive work on the problem is stressed.

Tea : Clonal Selection and Propagation

K. S. VENKATARAMANI
United Planters' Association of South India

Tea has been and is still a very important foreign exchange earner. Our tea industry now faces a real competition from other tea-growing countries, particularly Ceylon and East Africa. We have, therefore, to ensure that the quality and quantity of our produce do not fall short of standard and that, in fact, they do improve from good to better. Several factors may come to play in this but the use of the right kind of plant material alone in replanting and future plantings will have far-reaching consequences. Tea breeding has a great role to play, but breeding in the strict scientific sense and evolution of pure line races in the polymorphic species *Camellia sinensis* are time-consuming and beset with practical difficulties. Fortunately, a wealth of variation exists amongst the tea bush population in the existing plantations. Exploitation of such plant variability by careful selection for high yielding capacity, excellence of quality, and fair resistance to drought and some important pests and diseases, and vegetative propagation of the selected bushes would, therefore, appear to offer a ready means of developing improved planting material in this perennial beverage crop.

The work carried out during the past nine years in the Tea Scientific Department of the United Planters' Association of Southern India has shown that clonal selection is, indeed, a most rapid method of improving the planting stock in tea. Over 300 selections were made and after a careful study a dozen tea clones are now being released to the South Indian tea industry. Some of these selections have a high yield potentiality (about 3,000 kg. of made tea per hectare in five years from planting) and produce teas of excellent quality.

The study has also revealed a relationship between certain bush and shoot characters and yield and cup quality of teas made from these selections—orthotropic growth of shoots has a direct bearing on yield, and light colour of flush and pubescence of the leaves contribute to overall quality.

The technique of vegetative propagation employing 'a leaf and internode' cuttings has been standardised. The positive role of juvenility on rooting of tea cuttings has been established and, therefore, the importance of proper source of material for propagation purposes is stressed.

Differences are discerned in the chemical make-up of the various clones under investigation and attempts are being made to develop a chemotaxonomy of tea clones.

Acetylcholine-Atropine Antagonism as Determined by a Series of pA Values

M. B. GHARPURE
From the Medical College, Aurangabad

There is no agreement as regards the nature of the acetylcholine-atropine antagonism, that is whether it is competitive or 'not competitive'. An attempt was made previously by the author (1964) to settle this issue by determining the $pA_{5,001}$ and $pA_{25,01}$ values but the results did not indicate unequivocally that the antagonism is competitive. In the present work, six pA values, namely, pA_{2}, pA_{11}, pA_{101}, $pA_{1,001}$ $pA_{10,001}$ and $pA_{100,001}$[1] have been determined. Two more pA values, namely, $pA_{5,001}$ and $pA_{25,001}$ have also been determined. The results provide an overwhelming evidence to say that the acetylcholine-atropine antagonism is competitive. Why a compound like atropine which antagonizes acetylcholine competitively even at the level of its $pA_{10,001}$ - $pA_{100,001}$ values does not do so at the lower level of pA_{2}-pA_{10} (or pA_{2}-pA_{11}) values still remains an unsolved problem.

In the study of drug antagonism, such a large series of pA values and such high pA values for a pair of compounds have been determined for the first time by the author.

---

1. Gharpure, M. B., "The acetylcholine-atropine antagonism as determined by very high pA values," *Ind. Jour. Med. Res.*, 1964, **52**, 104.

DISTRIBUTION OF NICKEL IN THE MARINE SEDIMENTS OFF THE WEST COAST OF INDIA

P. S. N. MURTY, CH. M. RAO[*] AND C. V. G. REDDY[*]
National Institute of Oceanography, Panjim (Goa), India

THE distribution of trace elements and the possible factors influencing them in the shelf sediments off the west coast of India have been the subject of study for some time. In continuation of the results pertaining to phosphates, Murty *et al.*,[1] and Manganese, (Murty *et al.*[2]) estimations of nickel were carried out and the present paper gives an account of its distribution, and the relationship it bears to other important elements in these sediments.

The location of Stations from where the samples were collected are given in Fig. 1. The marine sediments fringing the west coast of India exhibit texturally, chemically and mineralogically certain well-defined distribution patterns. The inner shelf (upto 20 fms.) is covered by silty clays or clayey silts with very low carbonate content and this is followed seaward by a zone of silty or clayey sands on the rest of the shelf and slope regions characterised by a high carbonate content.[3] This is particularly so between Cochin and Karwar while off Bombay the shelf is covered for a greater part by fine-grained sediments. Studies on the organic matter (in the bulk sediments) have shown that the sediments in the inner shelf and the slope regions are characterised by a higher organic content than those in the region in between.[4] Manganese content shows a distinct trend in that it decreases in a direction seaward and away from land and also from north to south.[2] Clay minerals also exhibit regional variations. (*i*) The sediments off Bombay and Karwar are characterised by the presence of predominantly mixed layers of montmorillonite and illite with subordinate amounts of kaolinite group of minerals; (*ii*) the sediments off Mangalore by the presence of approximately equal proportions of mixed layers of montmorillonite and illite and kaolinite group of minerals; and (*iii*) the sediments off Kerala coast having predominantly kaolinite group of minerals with subordinate amounts of montmorillonite.

The estimations of nickel were carried out by the method described in Sandel[5] while iron and organic carbon were carried out respectively by the methods given by Snell and Snell[6] and ElWakeel and Riley.[7] All the analyses were carried out only on the silt and clay fractions and not on the bulk sample. All the colorimetric determinations were made on 'UNICAM' spectrophotometer SP 500.

Table I gives the contents of nickel, organic carbon, iron, manganese and calcium carbonate along with the depths from where the samples were collected. In order to understand the nature of relationship existing between nickel and other parameters analysed, correlation coefficients have been calculated. The values obtained between nickel and organic carbon, calcium carbonate, iron and manganese are 0·1680, – 0·2182, 0·3349 and 0·3703 respectively. The values of correlation coefficients obtained in respect of nickel and iron in relation to depth along each section are given in Table II. A careful examination of the data permits the following generalizations:

TABLE I

Stn. No.	Depth	Concentration of Nickel in ppm	Organic carbon in %	Calcium carbonate in %	Manganese in %	Iron in %
638	13	40	1·59	2·5	0·077	3·65
639	17	36	1·48	41·5	0·072	2·5
640	19	24	1·14	39·0	0·064	2·3
641	19	33	1·41	22·5	0·055	4·50
642	26	45	1·86	20·0	0·037	1·55
643	38	29	2·48	32·0	0·028	1·60
645	250	34	6·24	30·0	0·009	2·15
656	10	53	2·24	0·0	0·055	3·55
654	25	30	1·21	0·0	0·058	2·20
653	32	25	1·25	0·0	0·046	1·90
652	42	19	2·00	42·0	0·029	0·20
651	55	20	2·20	0·0	0·017	0·40
650	110	27	2·57	50·1	0·027	0·30
657	10	27	2·83	4·0	0·045	3·65
658	17	31	2·73	7·0	0·037	3·65
659	23	16	2·38	24·0	0·032	1·95
660	43	28	2·17	..	0·033	1·75
661	105	22	2·93	28·5	0·039	2·75
671	13	38	3·90	0·0	0·031	5·10
670	14	34	2·98	0·0	0·028	4·25
669	17	33	2·62	17·0	0·030	4·30
668	23	38	2·76	12·0	0·020	4·85
667	32	12	2·45	15·0	0·020	3·9
666	46	33	3·73	3·8	0·014	3·60

Note: Values of manganese and calcium carbonate are borrowed from Murty *et al.*[2] and Nair *et al.*[3] respectively.

(*i*) The fine-grained sediments in the inner shelf and the sediments in the slope region

---

[*] From the branch establishment of National Institute of Oceanography at Cochin.

TABLE II

Name of the section		r-value for nickel	r-value for iron
Off Bombay	..	−0·19	−0·65
Off Karwar	..	−0·46	−0·52
Off Mangalore	..	−0·26	−0·72
Off Cochin	..	−0·39	−0·38

r for manganese has not been calculated as it is clearly evident from the data that it decreases with depth.

contain relatively a higher amount of nickel than the sediments in the outer shelf. Even among the fine-grained sediments, the sediments off Bombay. Karwar and Cochin have relatively a higher concentration of nickel than the sediments off Mangalore.

(*ii*) Nickel co-varies with both manganese and iron. Relatively, it has a stronger correlation with manganese than with iron. It does not show any relationship with organic carbon.

(*iii*) A negative relationship exists between nickel and both calcium carbonate and depth of sampling.

Kraus-kopf[8] made an extensive study of the factors controlling the concentration of several trace elements in sea-water including nickel. He investigated in detail four processes for the removal of these elements namely (*i*) precipitation of insoluble compounds with ions normally present in sea-water, (*ii*) precipitation by sulphide ion in local regions of low oxidation potentials, (*iii*) adsorption by materials such as ferrous sulphide, hydrated ferric oxide, hydrated manganese dioxide and clay and (*iv*) removal by metabolic action of organisms. His results have shown that adsorption is the most important process for the removal of minor and trace elements from the sea-water and heir deposition in marine sediments. Nicholls and Loring[9] and Hirst[10] suggested that there s a correlation between nickel and organic carbon content of the sediments and they onsider that the latter acts as an adsorbant. Hogdahl[11] has shown that nickel is enriched n marine organisms relative to sea-water to greater extent. According to Chester[12] nickel may be probably removed permanently rom sea-water under conditions of low redox potential when organic rich sulphide-bearing ediments are formed.

In the present case it is possible that preciitation of nickel as insoluble compound does ot take place as the sea-water is greatly nder-saturated with regard to this element. Also, precipitation of nickel by sulphide is nlikely in the areas under study, in view of he fact that considerable mixing takes place n the shelf waters. pH measurements carried out by Rao and Madhavan[13] have shown that the environment is not the reducing type. Reports of heavy mortality of bottom animals[14] during certain seasons and consequent anoxic conditions are perhaps a transient or passing feature and not long enough to maintain low redox potentials and hence reducing conditions. It may be relevant to mention here that no sulphide odour is noticed in any of the samples collected.

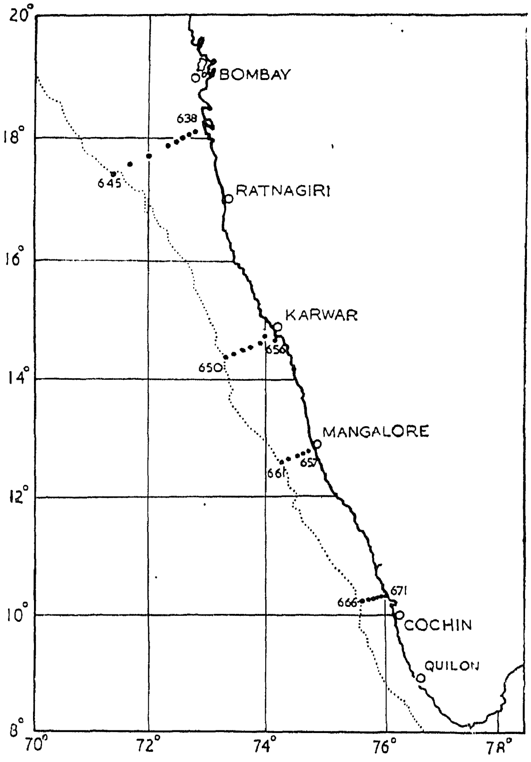


FIG. 1. Map showing the station locations.

Organic carbon in the silt and clay fraction follows the same trend as in the bulk samples. The distribution pattern observed in the sediments of (*a*) the inner shelf, (*b*) outer shelf and (*c*) slope regions has been attributed by Murty *et al.* (*loc. cit.*) respectively to (*i*) the highly productive nature of the coastal waters as a consequence of seasonal upwelling and the presence of fine-grained sediments in the inner shelf, (*ii*) the coarse-grained nature of the sediments in the outer shelf and the presence of oxygenated waters which destroy much of the organic matter and (*iii*) the preservation of organic matter in the slope sediments under oxygen poor waters. The organic carbon does not show any relationship with nickel in the present studies which indicates that it is not bound to organic carbon. The factors that favour organic carbon to act as an effective adsorbant are (*i*) the presence of high percentage of organic carbon in the sediments, (*ii*) absence of agitated and well-ventilated waters, (*iii*) slow rate of deposition and (*iv*) the presence of a reducing environment. Considering these factors and comparing the conditions obtaining in the different parts of the shelf, it could be seen that the organic carbon in the sediments of the outer shelf cannot act as an effective adsorbant. The inshore sediments, no doubt, contain a high percentage of organic carbon but the rapid rate of sedimentation taking place in this region prevents it from acting as an adsorbant as it will not be in effective contact with the overlying waters for a considerable period.

A negative relationship exists between nickel and carbonate content. This indicates that there is no enrichment of nickel in these sediments by the organisms in their tests.

Nickel co-varies with manganese and iron. Relatively, it has a stronger correlation with manganese. A comparison of the distribution patterns of manganese and nickel shows that they are closely similar in that (*i*) both show a negative trend with depth, (*ii*) in general both are enriched in the nearshore and slope sediments relatively to the sediments in the outer shelf, and (*iii*) both show a decreasing trend from north to south except in the case of the Cochin section where though manganese content is less, the nickel content is high. This similarity in distribution might suggest that they are both closely related in these sediments. Adsorption by clay minerals on their surfaces is considered to be more effective in nearshore areas owing to the higher concentration of suspended clay particles. Information available on the manganese content in the clay fraction of a few of the samples (Table III) shows that a considerable portion of manganese is concentrated in the clay fraction and that it shows the same trend as in the silt and clay fraction. The hydrographic conditions in the shelf region being similar along the different parts of the west coast of India, this can perhaps be attributed to (*i*) the differences in the source rocks present along the different parts along the west coast and (*ii*) the differences in the adsorption capacities of the different clay minerals present in the different regions. It is quite possible that nickel may also be simultaneously getting fixed up in the sediments by this process. Thus while this process may be operating it is not unlikely that a part of nickel might have entered the basin of deposition structurally combined with the sediment and from the present studies it is not possible to determine what proportion of nickel is derived from the sea-water and what proportion is detrital in origin.

TABLE III

Name of the section		Station No.	MnO content
Off Bombay	..	638	0·05
		642	0·03
Off Karwar	..	656	0·04
		652	0·03
Off Mangalore	..	657	0·02
		659	0·01
		661	0·02
Off Cochin	..	671	0·02
		669	0·01
		666	0·01

Along the Cochin section, the nickel content is high in spite of the fact that the manganese content is low. This may perhaps be due to (*i*) the presence of the basic rocks along this coast which contain a relatively higher content of nickel and (*ii*) the high content of iron in these sediments which may be scavenging the nickel from the waters. The relatively stronger correlation observed with iron than with manganese in the sediments of this section supports this surmise.

ACKNOWLEDGEMENT

The authors wish to thank Dr. N. K. Panikkar, Director, National Institute of Oceanography, Panjim (Goa), for his keen interest and encouragement in the present investigation and Shri R. Jayaraman, National Institute of Oceanography, Panjim, for his helpful suggestions in the preparation of this paper.

---

1. Murty, P. S. N., Reddy, C. V. G. and Varadachari, V. V. R., *Proc. Nat. Inst. Sci. India*, 1968, **34.**
2. —, Rao, Ch. M. and Reddy, C. V. G., *Curr. Sci.*, 1968, **37.**
3. Nair, R. R, and Abraham Pylee, *Bull. Nat. Inst. Sci. India*, 1968, **38.**
4. Murty, P. S. N., Reddy, C. V. G. and Varadachari, V. V. R., *Proc. Nat. Inst. Sci. India* (in press).
5. Sandell, E. B., *Colorimetric Determination of Traces of Metals*, Interscience, New York, 1950.
6. Snell, E. D. and Snell, C. T., *Colorimetric Method of Analysis*, I, 3rd ed., D. Van Nostrand Co., New York, 1949.
7. ElWakeel, S. K. and Riley, J. P., *J. Cons. Perm. Int. Explor. Mer.*, 1957, **22.**
8. Kraus-kopf, K. B., *Geochim. et Cosmoch. Acta*, 1956, **9.**
9. Nicholls, G. D. and Loving, D. H., *Ibid.*, 1962, **26.**
10. Hirst, D. M., *Ibid.*, 1962 *b*, **26.**
11. Hogdahl, O. T., *Trace Elements in the Ocean*, The Central Institute for Industrial Research, Oslo, 1963.
12. Chester, R., *Chemical Oceanography*, eds. J. P. Riley and G. Skirro, Academic Press, London and New York, Vol. **2.**
13. Rao, D. S. and Madhavan, N., *J. Mar. biol. Ass. India*, 1964, **2.**
14. Seshappa, G., *Nature, Lond.*, 1953, **171.**

LETTERS TO THE EDITOR

ISOTOPE EFFECT IN BROMINE IN PRESENCE OF SCAVENGER

The isotope effect study of bromine undergoing (n, γ) reaction has received much attention during the last decade. Nesmeyanov *et al.*[1] find higher organic yields for Br-82 than Br-80m over a wide range of scavenger concentrations for (n, γ) reactions with liquid halomethanes containing two halogens in the same molecule. However, they report that the effect is insignificant for compounds containing only one species of halogen or in the solid state. Earlier, the author has reported[2,3] the existence of isotope effect in radiobromine produced in (n, γ) process in liquid phase, employing the charged plate technique. The present work further supports the success of the technique adopted for observing the isotope effect with ethylene dibromide undergoing (n, γ) reaction in presence of bromine scavenger. The object of adding the scavenger to the system prior to irradiation was to suppress any sort of 'isotope effects' due to homogeneous thermal exchange reactions or impurities effects.

In isotope effect study of Br-80 and Br-82, about 250 ml of $C_2H_4Br_2$ with a 10^{-3} M.f. concentration of bromine scavenger was subjected to thermal neutron irradiation from a Ra + Be source of 300 mC strength. Towards the end of irradiation, the irradiated liquid was subjected to an electric field of 200 volts/cm., for periods of 1·5 hr. and 5·0 hr. to observe the effect on either electrode. The results obtained from the analyses of the decay curves of the collected radioactive species and the calculated relative yields (β) with the help of available cross-section (σ) of the corresponding target nuclei and its abundance (n) are given in Table I.

The higher enrichment of negatively-charged species of Br-80 and Br-82 was attempted on the basis of the reaction put forward by Gensler and Willard,[4] *viz.*, $RBr + e^- \rightarrow R + Br^-$ (suggesting the reaction $RBr^+ + e^- \rightarrow R + Br^-$). Such a reaction predominantly produces inactive Br^- in the system. Since the probability of the electron reacting with a freshly-produced active RBr^+ being negligible because of excess inactive RBr, the explanation suggested earlier[4] seems to be untenable.

The metastable states of bromine, *viz.*, Br-80m and Br-82m undergo isomeric transitions followed by internal conversion processes. Some of these conversions will initiate Auger cascades which account for positively-charged species of bromine. But in cases of internal conversion leading to X-ray emission, the metastable Br atoms bound to molecules will lead to Br^+ ions. Because the highly converted γ-ray leaves a vacancy in an inner shell subsequently filled by an outer electron. This process proceeds until one of the valency electrons is used. Therefore the Br-atom, which is bound in an organic compound, with the loss of the valency electron is set free as Br^+ ion. The Br^+ ions produced in this manner will be ample because of the high retentivity of active bromine in the target substance. Moreover, the extreme instability of the Br^+ ions leads to a greater fraction of it to be changed to Br^- finally during the transit through the medium under an applied electric field. The dielectric constant 4·97 of the medium is considered high enough to bring about this conversion resulting in a greater yield on the anode.

The characteristic values ($\beta/\sigma n$) for the anode and cathode of Table I show the occurrence of a marked isotope effect in the

TABLE I

Isotope effect in ethylene dibromide in presence of bromine scavenger

Duration of applied field (hr.)	Target data	Barns σ	n%	Product yield			
				Anode		Cathode	
				β	$\beta/\sigma n$	β	$\beta/\sigma n$
1·5	Br-81	3·5	49·5	1800	10·4	1300	8·0
	Br-79 (4·4 hr.)	2·9	50·5	840	5·7	440	3·0
	Br-79 (18 min.)	8·5	50·5	3341	7·7	1157	2·7
5·0	Br-81	3·5	49·5	5200	30·1	4700	27·0
	Br-79 (4·4 hr.)	2·9	50·5	2150	14·1	760	5·1
	Br-79 (18 min.)	8·5	50·5	6098	14·2	961	2·2

formation and collection of the isotopes, Br-80 and Br-82, in contrast with its absence between the two isomers, Br-80 m and Br-80, for the different durations of the applied field. The fractions of the positively-charged atoms may differ among the different isotopes of an element on account of the variation in their coefficients of internal conversion with the capturing nuclides. This seems to be one of the factors responsible for the occurrence of the isotope effect.

The author is grateful to Dr. B. M. Shukla and Prof. G. B. Singh for the laboratory facilities.

Department of Physics, A. Lal.
Banaras Hindu University,
Varanasi-5, *September* 1, 1969.

---

1. Nesmeyanov, A. N., Filatov, E. S., Borisov. E. A. and Shukla. B. M., *Proc. Symp. Chem. Effects of Nucl. Trans., I.A.E.A.*, Vienna, **1961**, **1**, 259.
2. Lal, A., *Ind. J. Phys.*, 1967, **41**, 39.
3. —, *Curr. Sci.*, 1967, **36**, 288.
4. Geissler. P. R. and Willard, J. E., *J. Phys. Chem.*, 1963, **67 B**, 1675.

ABSORPTION SPECTRUM OF MgI MOLECULE

The spectra of the diatomic magnesium halides were first photographed in a flame source by Olmsted.[1] Later, Walters and Barratt[2] observed the bands in absorption but did not propose any vibrational assignment. Morgan,[3] by passing gaseous chlorine, bromine and iodine over magnesium metal at 1,600° C. obtained the absorption spectra of MgCl, MgBr and MgI. He classified one system each for MgCl and MgBr in the regions $\lambda\lambda$ 3950-3600 and $\lambda\lambda$ 4000-3800 respectively and three regions of continuous absorption and one-band system lying between $\lambda\lambda$ 4200-4000 were obtained for MgI. However, only a tentative analysis was proposed for the MgI band system. Though the spectra of MgF, MgCl and MgBr have been studied in more detail by other workers,[4-11] no further work has been reported regarding the spectra of MgI molecule. Thus, the problem was undertaken for reinvestigation and the absorption studies were planned.

The vacuum graphite furnace described earlier[12] was used for the production of experimental vapour. Magnesium iodide was placed in a 15 cm. long graphite absorption tube with internal diameter of 5 mm. Nitrogen pressure of 60 cm. of mercury was maintained inside the furnace chamber for slow diffusion of the vapour from the experimental tube. Ilford N.40 process plates were used for recording the spectra on Hilger E 492 large quartz spectrographs. A 500-watt ribbon filament lamp was used as the source of continuum and copper arc spectrum as comparison standard. The new bands, observed in the visible region, could only be photographed either by using magnesium iodide or a mixture of magnesium metal and iodine. It was experimentally verified that magnesium or iodine separately did not give rise to these bands.

Thirty-four bands have been recorded by the author in region $\lambda\lambda$ 4220-3630. They include thirteen bands degraded to shorter wavelength and attributed to Morgan's[3] A-X system. The remaining twenty-one bands degrade to longer wavelength and have been grouped into three short systems, *viz.*, B-X, C-X and D-X. The tentative analysis of the A system proposed by Morgan has been found to be correct. Band head data along with visual estimates of intensities and classification for A-X system are given in Table I. Similar data for other systems are presented in Table II. The regions of continuous absorption, recorded by Morgan,[3] in the vicinity of 24980, 25290 and 25594 cm.$^{-1}$ have been identified as the (0, 2), (0, 1) and (0, 0) bands of the B-X system.

TABLE I

A-X system of MgI

λ (Å)	Int.	ν (cm.$^{-1}$)			v', v''
		Obs.	Calc.	Morgan[3]	
4216·9	1	23707	23708	..	(2, 4)
4164·1	3	24008	24007	24010	(0, 1)
4163·0	6	24014	24014	24016	(1, 2)
4161·8	5	24021	24021	24019	(2, 3)
4160·8	2	24027	24025	24026	(3, 4)
..	..	..	24029	24029	(4, 5)
..	..	..	24032	24036	(5, 6)
4110·3	8	24322	24322	24322	(0, 0)
4108·9	10	24330	24328	24329	(1, 1)
4108·0	8	24336	24333	24336	(2, 2)
4057·3	5	24640	24643	24640	(1, 0)
4055·8	5	24649	246 7	24646	(2, 1)
..	..	..	24650	24651	(3. 2)

The three systems, B-X, C-X and D-X are short and it is not possible to determine the upper state constants with certainty. However, well-marked and intense $v' = 0$ progressions are present in each case. For system C, an equally well-developed $v' = 1$ progression is also discernible. The situation is helpful in determining the ground state vibrational constants with reasonable certainty. The vibrational frequency (ω_e) values for the ground state (X) and first excited state (A) of magnesium halides are also shown in Fig. 1. The gradual decrease from fluoride to iodide follows smooth curves of the same general shape for

TABLE II

B–X, C–X and D–X systems of MgI

λ (Å)	Int.	ν (cm.⁻¹) Obs.	ν (cm.⁻¹) Calc.	(v′, v″)
		B–X system		
4002·0	3	24980	24983	(0, 2)
3952·8	9	25291	25287	(0, 1)
3904·5	10	25604	25602	(0, 0)
3860·2	1	25898	25897	(1, 0)
		C–X system		
4078·8	0	24510	24511	(0, 5)
4027·2	3	24824	24822	(0, 4)
3983·9	3	25094	25092	(1, 4)
3977·5	4	25134	25134	(0, 3)
3933·9	5	25413	25404	(1, 3)*
3928·4	4	25448	25447	(0, 2)
3887·5	1	25716	25717	(1, 2)
3880·1	3	25765	25761	(0, 1)
3840·6	5	26030	26031	(1, 1)
3834·0	8	26075	26076	(0, 0)
		D–X system		
3887·5	1	25716	25711	(1, 4)†
3884·8	0	25734	25728	(0, 3)*
3793·1	3	26356	26355	(0, 1)
3751·3	5	26650	26650	(1, 1)
3748·4	4	26670	26670	(0, 0)
3707·4	5	26965	26965	(1, 0)
3631·5	0	27529	27531	(3, 0)

* Masked ; measurement uncertain.
† Overlapped by (1, 2) band of C–X system.

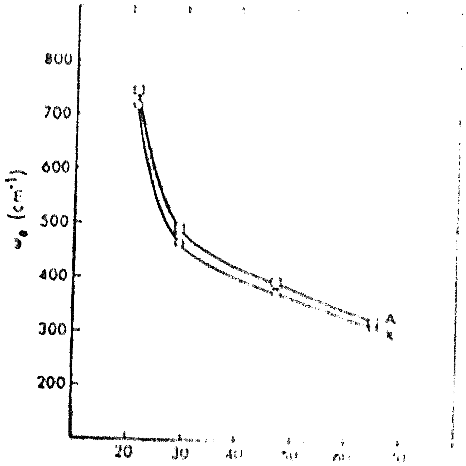


FIG. 1. Variation of vibrational frequency (ω_e) with the number of electrons (n_e) for magnesium halide.

both the states and the ground state vibrational frequency of 316·0 cm.⁻¹ for MgI, obtained by the present analyses, fits in very well. The ground state frequency proposed by Morgan also agrees well with this value. The near equality of ω_e' and ω_e'' values for A–X system indicates that the strongest bands of this system should fall upon a narrow Condon parabola. That this indeed is the case can be seen from Table III.

TABLE III

Intensity distribution in A–X system of MgI

v′ \ v″	0	1	2	3	4	5	6
0	8	3					
1	5	10	6				
2		5	8	5	1		
3			†		2		
4						†	
5							†

† Observed by Morgan only.

It has been noticed that few bands show sufficiently intense and wide structure and there is a possibility that some bands are being masked under these structures. This problem is enhanced by the closeness of lower state and upper state vibrational frequencies. The vibrational constants for MgI are given in Table IV.

TABLE IV

Constants for MgI (cm.⁻¹)

State	ν_{00}	ω_e	$\omega_e x_e$
D	26670	295	..
C	26076	270	..
B	25602	295	..
A	24372·0	323·0	1·00
X	0	316·0	0·50

For a meaningful comparison about the nature of excited states of MgI with other magnesium halides, studies on high dispersion are essential.

The author wishes to thank the Council of Scientific and Industrial Research, New Delhi, for financial assistance.

Physics Dept., R. YAMDAGNI.*
Allahabad University,
Allahabad, India, *September* 19, 1969.

* Present address : Chemistry Department, University of Alberta, Edmonton, Alberta, Canada.

1. Olmsted, C. M., *Z. Wiss. Phot.*, 1906, **4**, 255.
2. Walters, O. H. and Barratt, S., *Proc. Roy. Soc.*, 1928, **118 A**, 120.
3. Morgan, F., *Phys. Rev.*, 1936, **50**, 60.
4. Datta, S., *Proc. Roy. Soc.*, 1921, **99**, 436.
5. Jevons, W., *Ibid.*, 1929, **122**.
6. Parker, A. E., *Phys. Rev.*, 1935, **47**, 340.
7. Fowler, C. A., *Ibid.*, 1941, **59**, 642.
8. Harrington, R. E., *Thesis*, University of California, 1942.
9. Rao, V. S. and Rao, P. T., *Indian J. Phys.*, 1963, **37**, 640.
10. Patel, M. M. and Patel, P. D., *Ibid.*, 1968, **42**, 254.
11. Walker, T. E. H. and Richards, W. G., *J. Phys. B. Proc. Phys. Soc.* (Atomic Molecular Phys.) (GB). Ser., 1968, **1**, 2.
12. Harimohan and Majumdar, K., *Proc. Phys. Soc.*, 1961, **77**, 147.

THE KINETICS OF THE ADDITION OF BROMINE TO OLEFINIC COMPOUNDS—PART II

THE kinetics of the addition of bromine to some vinyl compounds in dry acetic acid medium has been recently shown to be of the third order.[1,2] We have also found that addition of water to the solvent enhanced the rate of the reaction. The third-order rate constant (k_3) increased with increasing water-content (or dielectric constant, D) of the medium. This shows that the activated complex is more polar than the reactants. Some correlations we have observed between the dielectric constant (or some other property) of the medium and the third-order rate constant of the reaction are reported in this communication.

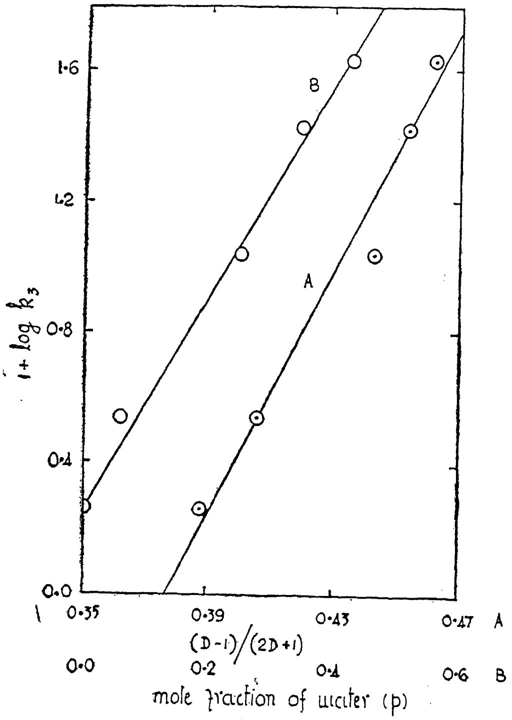


FIG. 1. Bromine-addition to methacrylamide at 30° C. in acetic acid-water mixed solvents containing 0 to 20% water (by volume). A—plot of log k_3 against (D−1)/(2D+1); B—plot of log k_3 against mole-fraction of water (p).

Rate measurements were made at 30° C. in various acetic acid-water mixed solvents (water-content being 0, 2, 10, 15 and 20% by volume). Equimolar initial concentrations of the reactants (methacrylamide and bromine) were used in all cases. For each solvent, the value of k_3 was evaluated by using the appropriate integrated rate equation, as described already.[1,2]

Figure 1 (line A) shows a plot of log k_3 against $(D-1)/(2D+1)$ for the reaction in anhydrous and aqueous acetic acids (dipole-dipole reaction).[3,4] The plot is fairly linear. The same set of experimental data, however, fit equally well into the empirical equation

$$k_{3(aq.)} = k_{3(dry)}\, e^{\alpha p}$$

proposed by Seshadri and Ganesan[5] for aromatic bromine substitution. A plot of log k_3 against p is quite linear (Fig. 1, line B). Here, $k_{3(aq.)}$ and $k_{3(dry)}$ are the third-order rate constants in aqueous and dry acetic acids, respectively, p is the mole-fraction of water in the solvent and α is a constant ($k_{3(aq.)} = k_{3(dry)}$, when $p = 0$).

When 30 to 70% (by volume) of water was added to the solvent (dry acetic acid), the reaction obeyed second-order kinetics. Under these conditions, linear plots similar to those in Fig. 1 were obtained using second-order rate constants.[6]

Physical Chemistry Dept., S. VISWANATHAN.
University of Madras, R. GANESAN.
Madras-25, *September* 23, 1969.

---

1. Viswanathan, S. and Ganesan, R., *Curr Sci.*, 1968, **37**, 102.
2. Ganesan, R. and Viswanathan, S., *Z. physik. chem. Neue Folge*, 1969, **66**, 243.
3. Laidler, K. J. and Eyring, H., *Ann. N. Y. Acad. Sci.*, **1940**, **39**, 303.
4. Frost, A. A. and Pearson, R. G., *Kinetic and Mechanism*, John Wiley & Sons, New York, 1962, Chapter VII.
5. Seshadri, K. V. and Ganesan, R., *Z. physik. chem. Neue Folge*, **1968**, **62**, 29.
6. Viswanathan, S., *Ph.D. Thesis*, University of Madras, 1969.

PHASE STUDIES IN THE SYSTEM : $Y\ Ta\ TiO_6$–$Nd\ Ta\ Ti\ O_6$

THE phase studies in the system $Y\ Nb\ Ti\ O_6$–$Nd\ Nb\ Ti\ O_6$ have been reported.[1] We now report similar studies in the system $Y\ Ta\ Ti\ O_6$ $Nd\ Ta\ Ti\ O_6$.

$Y\ Ta\ Ti\ O_6$ is isostructural with euxenite ($Y\ Nb\ Ti\ O_6$). The procedure adopted for the preparation of compositions between the end members and the method of X-ray analysis is the same as in the previous communication.[1]

The results obtained are given in Table I.

It is seen from Table I that only one single phase of euxenite exists upto the composition $Y_{0\cdot8}\ Nd_{0\cdot2}\ Ta\ Ti\ O_6$. A new phase $Nd\ Ta\ Ti\ O_6$ made its appearance along with euxenite phase at the composition $Y_{0\cdot6}\ Nd_{0\cdot4}\ Ta\ Ti\ O_6$. On

TABLE I

The system : Y Ta Ti O_6–Nd Ta Ti O_6

Composition	Phases present
1. $Y_{0.8}$ $Nd_{0.2}$ Ta Ti O_6	Euxenite (a = 5·530, b = 14·612, c = 5·175 Å)
2. $Y_{0.6}$ $Nd_{0.4}$ Ta Ti O_6	Euxenite (a = 5·548, b = 14·612, c = 5·173 Å) + Nd Ta Ti O_6 (trace)
3. $Y_{0.4}$ $Nd_{0.6}$ Ta Ti O_6	Nd Ta Ti O_6 (a = 5·906, b = 13·833, c = 8·619 Å)
4. $Y_{0.2}$ $Nd_{0.8}$ Ta Ti O_6	Nd Ta Ti O_6 (a = 5·908, b = 13·834, c = 8·617 Å)
5. Nd Ta Ti O_6	Nd Ta Ti O_6 (a = 5·909, b = 13·834, c = 8·618 Å)

increasing the proportion of neodymium in later compositions, the lines corresponding to the euxenite phase disappeared and the lines due to the new phase Nd Ta Ti O_6 increased in intensity. The disappearance of the lines due to the euxenite phase indicates the breakdown of the euxenite lattice.

This new phase which has not so far been reported in literature is indexed on the basis of orthorhombic unit cell with the following lattice dimensions :

a = 5·909, *b* = 13·834, *c* = 8·618 Å.

Department of Physics, P. D. DESHPANDE.
and
Department of Inorganic V. S. DARSHANE.
and Structural Chemistry, V. V. DESHPANDE.
Institute of Science, Nagpur,
September 16, 1969.

---

1. Deshpande, V. V. and Rama Rao, K., *Curr. Sci.*, 1968, **37**, 608.

VINYL POLYMERISATION INITIATED BY REDOX SYSTEMS BASED ON TRIVALENT MANGANESE

OXIDATION of organic and inorganic substrates[1,2] by Mn^{3+} has been investigated in detail. Free radical intermediates in some of these reactions have been proved by initiation of vinyl polymerisation. Grafting of vinyl polymers on cellulose with the use of Mn^{3+} has been reported.[3] We report some of our results on the kinetics of polymerisation of vinyl monomers like acrylonitrile (AN) and methyl methacrylate (MMA) with Mn^{3+} and reducing agents like acetone (Ac), diacetone alcohol (DA) and malonic acid (MA).

Mn^{3+} stock solutions were prepared by the electrolytic oxidation of the appropriate Mn^{2+} salt solution (0·4–0·5 molar) in 4–5 molar sulphuric acid or perchloric acid at a platinum anode.[4,5] Freshly prepared solutions were analysed for Mn^{3+} by cerimetry, total manganese by EDTA titration[6] and free acid by ion exchange, and immediately used. The ratio of Mn^{2+}/Mn^{3+} was kept as high as possible to avoid disproportionation of Mn^{3+}.[4,5] Doubly distilled and deionised water was used throughout. AnalaR acetone was purified by standard methods. The monomers and diacetone alcohol were purified by distillation under vacuum in an atmosphere of N_2. Malonic acid was recrystallised from benzene-ethanol (m.p. 135·5°).

The more reactive substrate like malonic acid was tried at 10–15° C in sulphuric acid. Others were tried at 30° C in perchloric acid. The experimental set-up and procedure were as described earlier for the Co^{3+} initiated polymerisation.[7] Immediate precipitation of polymer showed absence of induction period and steady rates of polymerisation could be achieved in 10–45 minutes depending on the reducing agent, monomer, acid medium and temperature. No polymer was formed without a reducing agent, showing that there was no reaction between monomers and Mn^{3+}. Acrylonitrile gave three different types of kinetics. Rates of Mn^{3+} ion disappearance ($-d\,Mn^{3+}/dt$) were proportional to Mn^{3+} in all cases. These rates are independent of monomer concentration with malonic acid and diacetone alcohol but vary as M^1 with acetone (Fig. 1). Even with acetone $-d\,Mn^{3+}/dt$ becomes independent of M at high Ac. $-d\,Mn^{3+}/dt$ tends to increase with reducing agent in all cases, but soon becomes constant (Fig. 1). Rates of polymerisation ($-dM/dt$) show an order in monomer of 3/2 with acetone and malonic acid (Fig. 2), but vary as M^1 with diacetone alcohol. These rates show an order in Mn^{3+} of ½ with acetone but are independent of Mn^{3+} with the others. For moderate concentrations of Ac, $-dM/dt$ varies as $Ac^{\frac{1}{2}}$. With diacetone alcohol, $-dM/dt$ varies as DA^1, whereas with malonic acid rates increase with MA but become independent of MA at high concentrations (Fig. 2). With the MMA–MA system, $-dM/dt$ shows an increase with Mn^{3+}, but other features are similar to those found with acrylonitrile (Figs. 1, 2).

These observations may be accounted for by the following scheme. All the substrates form complexes of varying stability with Mn^{3+}. Slow decomposition of the complex produces the sole initiating radical except with acetone where a monomer molecule is involved in the radical production step.[8] The radical can react with

THE KINETICS OF THE ADDITION OF BROMINE TO OLEFINIC COMPOUNDS—PART II

THE kinetics of the addition of bromine to some vinyl compounds in dry acetic acid medium has been recently shown to be of the third order.[1,2] We have also found that addition of water to the solvent enhanced the rate of the reaction. The third-order rate constant (k_3) increased with increasing water-content (or dielectric constant, D) of the medium. This shows that the activated complex is more polar than the reactants. Some correlations we have observed between the dielectric constant (or some other property) of the medium and the third-order rate constant of the reaction are reported in this communication.

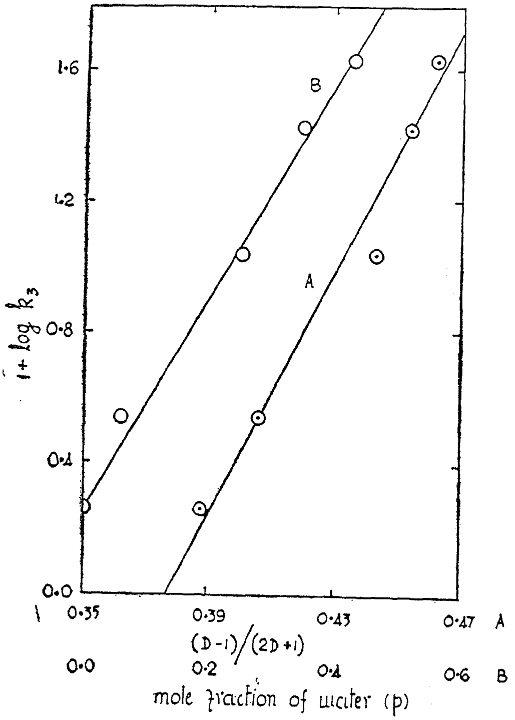


FIG. 1. Bromine-addition to methacrylamide at 30° C. in acetic acid-water mixed solvents containing 0 to 20% water (by volume). A—plot of log k_3 against (D−1)/(2D+1); B—plot of log k_3 against mole-fraction of water (p).

Rate measurements were made at 30° C. in various acetic acid-water mixed solvents (water-content being 0, 2, 10, 15 and 20% by volume). Equimolar initial concentrations of the reactants (methacrylamide and bromine) were used in all cases. For each solvent, the value of k_3 was evaluated by using the appropriate integrated rate equation, as described already.[1,2]

Figure 1 (line A) shows a plot of log k_3 against $(D-1)/(2D+1)$ for the reaction in anhydrous and aqueous acetic acids (dipole-dipole reaction).[3,4] The plot is fairly linear. The same set of experimental data, however, fit equally well into the empirical equation

$$k_{3(aq.)} = k_{3(dry)}\, e^{\alpha p}$$

proposed by Seshadri and Ganesan[5] for aromatic bromine substitution. A plot of log k_3 against p is quite linear (Fig. 1, line B). Here, $k_{3\,(aq.)}$ and $k_{3\,(dry)}$ are the third-order rate constants in aqueous and dry acetic acids, respectively, p is the mole-fraction of water in the solvent and α is a constant ($k_{3\,(aq.)} = k_{3\,(dry)}$, when $p = 0$).

When 30 to 70% (by volume) of water was added to the solvent (dry acetic acid), the reaction obeyed second-order kinetics. Under these conditions, linear plots similar to those in Fig. 1 were obtained using second-order rate constants.[6]

Physical Chemistry Dept., S. VISWANATHAN.
University of Madras, R. GANESAN.
Madras-25, *September* 23, 1969.

1. Viswanathan, S. and Ganesan, R., *Curr Sci.*, 1968, **37**, 102.
2. Ganesan, R. and Viswanathan, S., *Z. physik. chem. Neue Folge*, 1969, **66**, 243.
3. Laidler, K. J. and Eyring, H., *Ann. N. Y. Acad. Sci.*, 1940, **39**, 303.
4. Frost, A. A. and Pearson, R. G., *Kinetic and Mechanism*, John Wiley & Sons, New York, 1962, Chapter VII.
5. Seshadri, K. V. and Ganesan, R., *Z. physik. chem. Neue Folge*, 1968, **62**, 29.
6. Viswanathan, S., *Ph.D. Thesis*, University of Madras, 1969.

PHASE STUDIES IN THE SYSTEM : Y Ta TiO$_6$-Nd Ta Ti O$_6$

THE phase studies in the system Y Nb Ti O$_6$-Nd Nb Ti O$_6$ have been reported.[1] We now report similar studies in the system Y Ta Ti O$_6$ Nd Ta Ti O$_6$.

Y Ta Ti O$_6$ is isostructural with euxenite (Y Nb Ti O$_6$). The procedure adopted for the preparation of compositions between the end members and the method of X-ray analysis is the same as in the previous communication.[1]

The results obtained are given in Table I.

It is seen from Table I that only one single phase of euxenite exists upto the composition Y$_{0\cdot8}$ Nd$_{0\cdot2}$ Ta Ti O$_6$. A new phase Nd Ta Ti O$_6$ made its appearance along with euxenite phase at the composition Y$_{0\cdot6}$ Nd$_{0\cdot4}$ Ta Ti O$_6$. On

TABLE I
The system : Y Ta Ti O_6–Nd Ta Ti O_6

Composition	Phases present
1. $Y_{0.8}Nd_{0.2}$ Ta Ti O_6	Euxenite (a = 5·530, b = 14·612, c = 5·175 Å)
2. $Y_{0.6}Nd_{0.4}$ Ta Ti O_6	Euxenite (a = 5·548, b = 14·612, c = 5·173 Å) + Nd Ta Ti O_6 (trace)
3. $Y_{0.4}Nd_{0.6}$ Ta Ti O_6	Nd Ta Ti O_6 (a = 5·906, b = 13·833, c = 8·619 Å)
4. $Y_{0.2}Nd_{0.8}$ Ta Ti O_6	Nd Ta Ti O_6 (a = 5·908, b = 13·834, c = 8·617 Å)
5. Nd Ta Ti O_6	Nd Ta Ti O_6 (a = 5·909, b = 13·834, c = 8·618 Å)

increasing the proportion of neodymium in later compositions, the lines corresponding to the euxenite phase disappeared and the lines due to the new phase Nd Ta Ti O_6 increased in intensity. The disappearance of the lines due to the euxenite phase indicates the breakdown of the euxenite lattice.

This new phase which has not so far been reported in literature is indexed on the basis of orthorhombic unit cell with the following lattice dimensions:

a = 5·909, b = 13·834, c = 8·618 Å.

Department of Physics, and
Department of Inorganic and Structural Chemistry,
Institute of Science, Nagpur,
September 16, 1969

P. D. DESHPANDE.
V. S. DARSHANE.
V. V. DESHPANDE.

---

1. Deshpande, V. V. and Rama Rao, K., *Curr. Sci.*, 1968, 37, 668.

VINYL POLYMERISATION INITIATED BY REDOX SYSTEMS BASED ON TRIVALENT MANGANESE

OXIDATION of organic and inorganic substrates[1,2] by Mn^{3+} has been investigated in detail. Free radical intermediates in some of these reactions have been proved by initiation of vinyl polymerisation. Grafting of vinyl polymers on cellulose with the use of Mn^{3+} has been reported.[3] We report some of our results on the kinetics of polymerisation of vinyl monomers like acrylonitrile (AN) and methyl methacrylate (MMA) with Mn^{3+} and reducing agents like acetone (Ac), diacetone alcohol (DA) and malonic acid (MA).

Mn^{3+} stock solutions were prepared by the electrolytic oxidation of the appropriate Mn^{2+} salt solution (0·4–0·5 molar) in 4·5 molar sulphuric acid or perchloric acid at a platinum anode.[4,5] Freshly prepared solutions were analysed for Mn^{3+} by cerimetry, total manganese by EDTA titration[6] and free acid by ion exchange, and immediately used. The ratio of Mn^{2+} : Mn^{3+} was kept as high as possible to avoid disproportionation of Mn^{3+}.[4] Doubly distilled and deionised water was used throughout. AnalaR acetone was purified by standard methods. The monomers and diacetone alcohol were purified by distillation under vacuum in an atmosphere of N_2. Malonic acid was recrystallised from benzene-ethanol (m.p. 135·5°).

The more reactive substrate like malonic acid was tried at 10–15° C in sulphuric acid. Others were tried at 30° C, in perchloric acid. The experimental set-up and procedure were as described earlier for the Co^{3+} initiated polymerisation.[7] Immediate precipitation of polymer showed absence of induction period and steady rates of polymerisation could be achieved in 10–45 minutes depending on the reducing agent, monomer, acid medium and temperature. No polymer was formed without a reducing agent, showing that there was no reaction between monomers and Mn^{3+}. Acrylonitrile gave three different types of kinetics. Rates of Mn^{3+} ion disappearance ($-d\,Mn^{3+}/dt$) were proportional to Mn^{3+} in all cases. These rates are independent of monomer concentration with malonic acid and diacetone alcohol but vary as M^1 with acetone (Fig. 1). Even with acetone $-d\,Mn^{3+}/dt$ becomes independent of M at high Ac. $-d\,Mn^{3+}/dt$ tends to increase with reducing agent in all cases, but soon becomes constant (Fig. 1). Rates of polymerisation ($-d\,M/dt$) show an order in monomer of 3/2 with acetone and malonic acid (Fig. 2), but vary as M^1 with diacetone alcohol. These rates show an order in Mn^{3+} of ½ with acetone but are independent of Mn^{3+} with the others. For moderate concentrations of Ac, $-dM/dt$ varies as $Ac^{\frac{1}{2}}$. With diacetone alcohol, $-dM/dt$ varies as DA^1, whereas with malonic acid rates increase with MA but become independent of MA at high concentrations (Fig. 2). With the MMA–MA system, $-dM/dt$ shows an increase with Mn^{3+}, but other features are similar to those found with acrylonitrile (Figs. 1, 2).

These observations may be accounted for by the following scheme. All the substrates form complexes of varying stability with Mn^{3+}. Slow decomposition of the complex produces the sole initiating radical except with acetone where a monomer molecule is involved in the radical production step.[8] The radical can react with

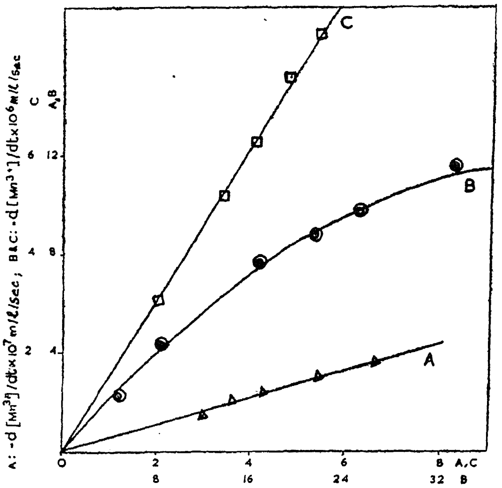


FIG. 1. A. M × 10 m/l ; Ac= 0·8174 m/l ; Mn^{3+} = 9·04 × 10^{-4} m/l , 30° C. B. MA × 10^4 m/l ; AN = 0·5010 m/l; Mn^{3+} = 4·104×10^{-3} m/l. 15° C. C. Mn^{3+} × 10^3 m/l; MA = 6·498 × 10^{-3} m/l ; MMA = 0·07011 m/l; 10° C.

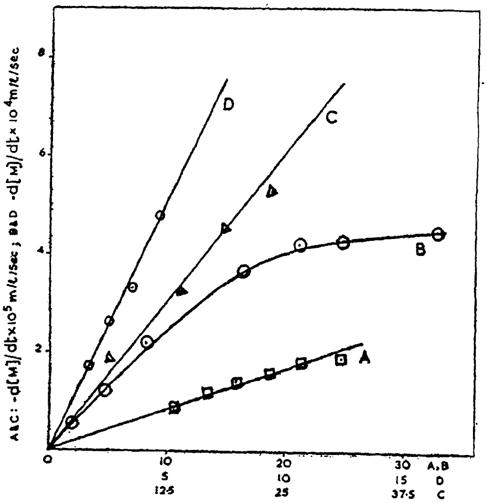


FIG. 2. A. DA × 10^2 m/l; Mn^{3+}=1·642×10^{-3} M/l ; AN=0·501 m/l ; 30° C. B. MA×10^4 m/l ; Mn^{3+}= 4·103 × 10^{-3} m/l ; AN = 0·501 m/l ; 15° C. C. $(MMA)^{3/2}$×10^3 $(m/l)^{3/2}$; Mn^{3+}=3·991 × 10^{-3} m/l ; MA = 8·114 × 10^{-4} m/l, 10° C. D. $(AN)^{3/2}$ × 10 $(m/l)^{3/2}$; Mn^{3+} = 3·806 × 10^{-3}m/l ; MA = 1·863 × 10^{-3} m/l, 15° C.

monomer or be oxidised further by Mn^{3+}. Growing radicals may be terminated by mutual interaction, by Mn^{3+} ions or by primary radicals. Mutual termination coupled with negligible oxidation of primary radicals would result in a monomer order of 3/2 and ½ orders in Mn^{3+} and Ac. Considerable oxidation of primary radicals and mutual termination would lead to a 3/2 order in monomer and 0 order in Mn^{3+} with the acrylonitrile-malonic acid system. At high malonic acid concentrations, however, a 0 order in MA would result due to termination by primary radicals. A similar mechanism will account for the results with MMA oxidation of primary radicals occurring to a much lesser extent than with acrylonitrile. Termination by Mn^{3+} and very little oxidation of primary radicals would account for the data with diacetone alcohol.

We thank the C.S.I.R. for the award of a Research Fellowship to one of us (N. G.) and Prof. M. V. C. Sastry for his interest.

Dept. of Chemistry, N. GANGA DEVI.
Indian Inst. of Technology, V. MAHADEVAN.
Madras-36, *September* 10, 1969.

---

1. Waters, W. A. and Littler, J. S., *Oxidation in Organic Chemistry*, Ed. K. B. Wiberg, Academic Press, 1965. Vol. I, Chater 3
2. Wells, C. F., *et al.*, *J. Chem. Soc (London)*, 1968, Part A, pp. 577, 665, 1622, 1626.
3. Singh, H., Thamby, R. T. and Chipalkatti, V. B., *J. Polymer Sci.*, 1965, **3 A**, 4289.
4. Wells, C. F. and Davies, G., *Nature*, 1965, **205**, 692.
5. Selim, R. G. and Lingane, J. J., *Anal. Chim. Acta*, 1959, **21**, 536.
6. Vogel, A. I., *Quantitative Inorganic Analysis*, Longmans Green & Co.. 1962.
7. Jijie, K., Santappa M. and Mahadevan, V., *J. Polymer. Sci.*, 1966, **4 A**, 377.
8. Bamford, C. H., *Pure and Applied Chemistry*, 1967, **15**, 333.

THE USE OF SOIL PERFUSION TECHNIQUE FOR THE ISOLATION OF TRIACETIN SPLITTING MICROBIAL CULTURE

THE soil perfusion technique developed by Lees and Quastel[1] for the study of the metabolic activities of soil could be conveniently employed for the isolation of micro-organisms having desired metabolic activities. Using this technique, it has been possible in the present studies to isolate an organism having the capacity to split a simple triglyceride like triacetin.

The apparatus designed by Audus,[2] where a column of soil, in the form of sieved air-dried crumbs, is perfused with oxygenated or aerated substrates by a circulatory technique ensuring a continuous perfusion of the soil bed, was employed in the present studies. Triacetin solutions were used for perfusion and the metabolism of the substrate was followed by estimating glycerol periodically in the perfusate, using the method of Korn[3] which involves oxidation by periodate to formaldehyde and development of stable colour with chromotropic acid. The residual triacetin was estimated as glycerol after saponification.

Soil crumbs were separately perfused 3 times for 72 hours each with 200 ml. aliquots of 0·01 M triacetin to stabilise the soil samples and enrich them with micro-organisms having the desired properties. Perfusion experiments were then carried out with 0·01 M, 0·025 M and 0·05 M solutions of triacetin in that order.

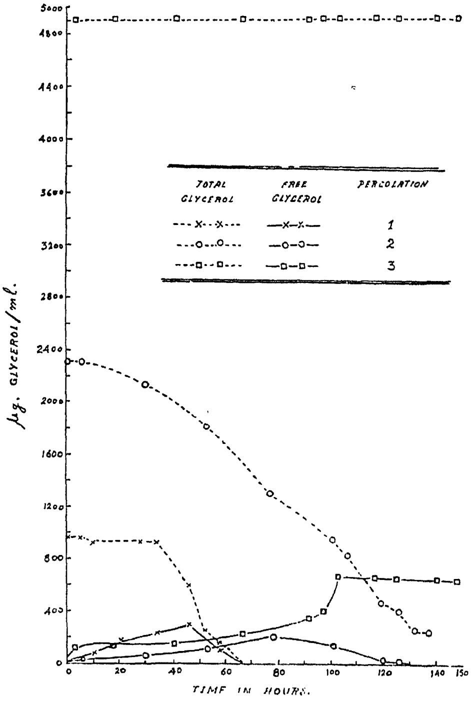


FIG. 1

Figure 1 represents typical results obtained with a garden soil responding to triacetin. With a 0·01 M solution of triacetin, the free glycerol increased upto 48 hours and disappeared thereafter, although total glycerol contained to decrease. This is indicative of simultaneous breakdown to glycerol and its utilisation by the soil microflora. Perfusion of this partially enriched soil with 0·025 M triacetin resulted in a saturation of the triacetin-splitting activity as seen from the presence of substantial amount of triacetin in the perfusate even after 126 hours. Further perfusion with 0·05 M solution of triacetin showed that although triacetin is split upto 117 hours, the total glycerol remained the same, indicative of the establishment of a state comparable to resting cells. At this stage, the perfusate showed predominance of one form, a unicellular type with scattered hyphæ and buds indicating the presence of yeast-like fungus.

The organism was isolated by the pour plate technique from the dried stabilised soil crumbs. The presence of both true and pseudomycelia and the absence of ascospores on potato and carrot plugs and the mirror images on the back of maltose-agar plates lead to Fungi imperfecti family *Crystococcaceæ*. The ability to reproduce both by budding and fission and also appearance of a true and pseudomycelia along with blastospores and arthrospores are characteristics typical of the genus *Trichosporon*. The formation of pellicles, the inability to ferment sugars, the ability to assimilate sugars, ethanol, nitrate and the fat-splitting nature are characteristics of the species of *Trichosporon pullulans* under the genus *Trichosporon* by Lodder and Kreger.[4] The morphological and physiological properties of the species were identical with *Trichosporon pullulans* described in yeast taxonomy.

Studies on hand reveal the constitutive nature of the triacetin-splitting activity in this organism. This activity is being purified for studies on the specificity of action.

Our thanks are due to Dr. Yvonne Freitas for much useful discussions.

Dept. of Chem. Tech., C. M. REDDY.
University of Bombay, D. V. TAMHANE.
Matunga Road,
Bombay-19, *September* 5, 1969.

---

1. Lees, H., and Quastel, J. H., *Chemistry and Industry* 1944, **26**, 238; *Biochem. J.*, 1946, **40**, 803, 815, 824.
2. Audus, L. J., *Nature*, **1946**, **158**, 419.
3. Korn, E. D., *J. Biological Chem.*, 1955, **215**, 15.
4. Lodder, J. and Kreger-Van Rij, N. J. W., *The Yeasts, A Text-book of Yeast Taxonomy*, North Holland Publishing Co., Amsterdam, 1952.

THE SEED MUCILAGE OF *OCIMUM CANUM*, SIMS.

THE capsular mucilage present in the seeds of *Ocimum canum* has been isolated in 7% yield on seed weight basis, by cold water extraction and alcohol precipitation. The crude mucilage, an asbestos-like material, was found to contain on dry weight basis (figures expressed in percentage): N, nil; OCH_3, 2·14; OAc, 4·01; CCH_3, 0·38; ash, 2·32; lipids, free 24 and bound[1] 5 and uronic acid by decarboxylation method,[2] 8·15.

The mucilage, after solubilization with 72% sulphuric acid at ice-bath temperature, was hydrolyzed with 4% sulphuric acid for 18 hours

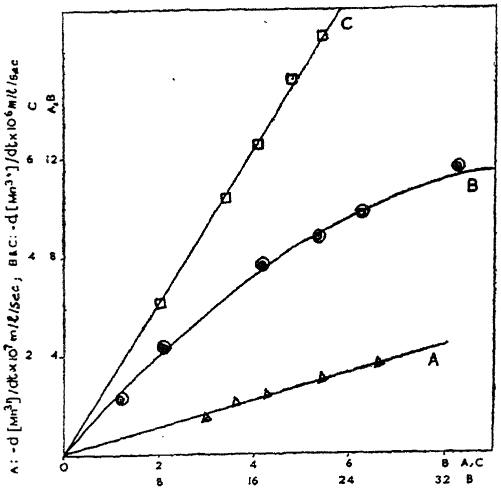


FIG. 1. A. M × 10 m/l; Ac = 0·8174 m/l; Mn^{3+} = 9·04 × 10^{-4} m/l, 30° C. B. MA × 10^4 m/l; AN = 0·5010 m/l; Mn^{3+} = 4·104 × 10^{-3} m/l. 15° C. C. Mn^{3+} × 10^3 m/l; MA = 6·498 × 10^{-3} m/l; MMA = 0·07011 m/l, 10° C.

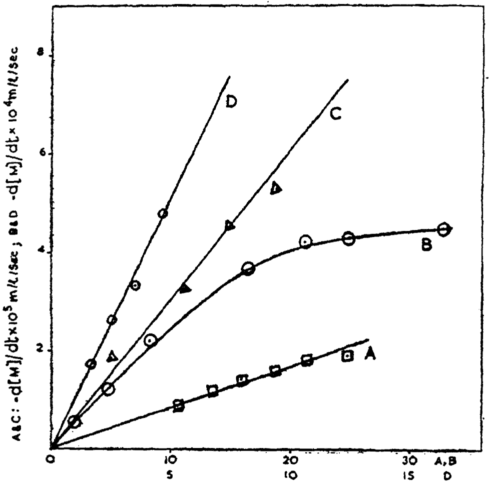


FIG. 2. A. DA × 10^2 m/l; Mn^{3+} = 1·642 × 10^{-3} M/l; AN = 0·501 m/l; 30° C. B. MA × 10^4 m/l; Mn^{3+} = 4·103 × 10^{-3} m/l; AN = 0·501 m/l; 15° C. C. $(MMA)^{3/2}$ × 10^3 $(m/l)^{3/2}$; Mn^{3+} = 3·991 × 10^{-3} m/l; MA = 8·114 × 10^{-4} m/l, 10° C. D. $(AN)^{3/2}$ × 10 $(m/l)^{3/2}$; Mn^{3+} = 3·806 × 10^{-3} m/l; MA = 1·863 × 10^{-3} m/l, 15° C.

monomer or be oxidised further by Mn^{3+}. Growing radicals may be terminated by mutual interaction, by Mn^{3+} ions or by primary radicals. Mutual termination coupled with negligible oxidation of primary radicals would result in a monomer order of 3/2 and ½ orders in Mn^{3+} and Ac. Considerable oxidation of primary radicals and mutual termination would lead to a 3/2 order in monomer and 0 order in Mn^{3+} with the acrylonitrile-malonic acid system. At high malonic acid concentrations, however, a 0 order in MA would result due to termination by primary radicals. A similar mechanism will account for the results with MMA oxidation of primary radicals occurring to a much lesser extent than with acrylonitrile. Termination by Mn^{3+} and very little oxidation of primary radicals would account for the data with diacetone alcohol.

We thank the C.S.I.R. for the award of a Research Fellowship to one of us (N. G.) and Prof. M. V. C. Sastry for his interest.

Dept. of Chemistry, N. GANGA DEVI.
Indian Inst. of Technology, V. MAHADEVAN.
Madras-36, *September* 10, 1969.

---

1. Waters, W. A. and Littler, J. S., *Oxidation in Organic Chemistry*, Ed. K. B. Wiberg, Academic Press, 1965. Vol. I, Chater 3.
2. Wells, C. F., *et al.*, *J. Chem. Soc* (*London*), 1968, Part A, pp. 577, 665, 1622, 1626.
3. Singh, H., Thamby, R. T. and Chipalkatti, V. B., *J. Polymer Sci.*, 1965, **3 A**, 4289.
4. Wells, C. F. and Davies, G., *Nature*, 1965, **205**, 692.
5. Selim, R. G. and Lingane, J. J., *Anal. Chim. Acta*, 1959, **21**, 536.
6. Vogel, A. I., *Quantitative Inorganic Analysis*, Longmans Green & Co., 1962.
7. Jijie, K., Santappa M. and Mahadevan, V., *J. Polymer. Sci.*, 1966, **4 A**, 377.
8. Bamford, C. H., *Pure and Applied Chemistry*, 1967, **15**, 333.

THE USE OF SOIL PERFUSION TECHNIQUE FOR THE ISOLATION OF TRIACETIN SPLITTING MICROBIAL CULTURE

THE soil perfusion technique developed by Lees and Quastel[1] for the study of the metabolic activities of soil could be conveniently employed for the isolation of micro-organisms having desired metabolic activities. Using this technique, it has been possible in the present studies to isolate an organism having the capacity to split a simple triglyceride like triacetin.

The apparatus designed by Audus,[2] where a column of soil, in the form of sieved air-dried crumbs, is perfused with oxygenated or aerated substrates by a circulatory technique ensuring a continuous perfusion of the soil bed, was employed in the present studies. Triacetin solutions were used for perfusion and the metabolism of the substrate was followed by estimating glycerol periodically in the perfusate, using the method of Korn[3] which involves oxidation by periodate to formaldehyde and development of stable colour with chromotropic acid. The residual triacetin was estimated as glycerol after saponification.

Soil crumbs were separately perfused 3 times for 72 hours each with 200 ml. aliquots of 0·01 M triacetin to stabilise the soil samples and enrich them with micro-organisms having the desired properties. Perfusion experiments were then carried out with 0·01 M, 0·025 M and 0·05 M solutions of triacetin in that order.

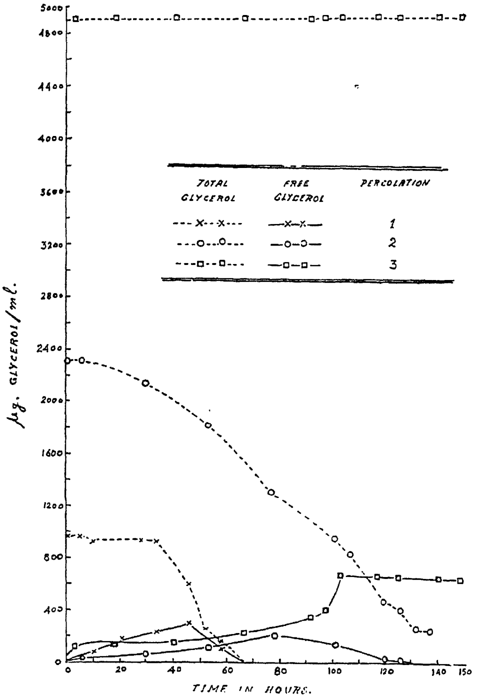


FIG. 1

Figure 1 represents typical results obtained with a garden soil responding to triacetin. With a 0·01 M solution of triacetin, the free glycerol increased upto 48 hours and disappeared thereafter, although total glycerol contained to decrease. This is indicative of simultaneous breakdown to glycerol and its utilisation by the soil microflora. Perfusion of this partially enriched soil with 0·025 M triacetin resulted in a saturation of the triacetin-splitting activity as seen from the presence of substantial amount of triacetin in the perfusate even after 126 hours. Further perfusion with 0·05 M solution of triacetin showed that although triacetin is split upto 117 hours, the total glycerol remained the same, indicative of the establishment of a state comparable to resting cells. At this stage, the perfusate showed predominance of one form, a unicellular type with scattered hyphæ and buds indicating the presence of yeast-like fungus.

The organism was isolated by the pour plate technique from the dried stabilised soil crumbs. The presence of both true and pseudomycelia and the absence of ascospores on potato and carrot plugs and the mirror images on the back of maltose-agar plates lead to Fungi imperfecti family *Crystococcaceæ*. The ability to reproduce both by budding and fission and also appearance of a true and pseudomycelia along with blastospores and arthrospores are characteristics typical of the genus *Trichosporon*. The formation of pellicles, the inability to ferment sugars, the ability to assimilate sugars, ethanol, nitrate and the fat-splitting nature are characteristics of the species of *Trichosporon pullulans* under the genus *Trichosporon* by Lodder and Kreger.[4] The morphological and physiological properties of the species were identical with *Trichosporon pullulans* described in yeast taxonomy.

Studies on hand reveal the constitutive nature of the triacetin-splitting activity in this organism. This activity is being purified for studies on the specificity of action.

Our thanks are due to Dr. Yvonne Freitas for much useful discussions.

Dept. of Chem. Tech., C. M. REDDY.
University of Bombay, D. V. TAMHANE.
Matunga Road,
Bombay-19, *September* 5, 1969.

---

1. Lees, H., and Quastel, J. H., *Chemistry and Industry* 1944, **26**, 238; *Biochem J.*, 1946, **40**, 803, 815, 824.
2. Audus, L. J., *Nature*, 1946, **158**, 419.
3. Korn, E. D., *J. Biological Chem.*, 1955, **215**, 15.
4. Lodder, J. and Kreger-Van Rij, N. J. W., *The Yeasts, A Text-book of Yeast Taxonomy*, North Holland Publishing Co., Amsterdam, 1952.

THE SEED MUCILAGE OF *OCIMUM CANUM*, SIMS.

THE capsular mucilage present in the seeds of *Ocimum canum* has been isolated in 7% yield on seed weight basis, by cold water extraction and alcohol precipitation. The crude mucilage, an asbestos-like material, was found to contain on dry weight basis (figures expressed in percentage): N, nil; OCH$_3$, 2·14; OAc, 4·01; CCH$_3$, 0·38; ash, 2·32; lipids, free 24 and bound[1] 5 and uronic acid by decarboxylation method,[2] 8·15.

The mucilage, after solubilization with 72% sulphuric acid at ice-bath temperature, was hydrolyzed with 4% sulphuric acid for 18 hours on a boiling water-bath. The hydrolysate, after neutralization with barium carbonate and removal of barium ions with amberlite IR-120 (H^+) resin, was evaporated to a syrup under reduced pressure. Paper chromatographic examination on Whatman number 1 filter-paper in ethyl acetate : pyridine : water, 10 : 4 : 3, V/V and *n*-butanol : ethanol : water, 4 : 1 : 5, V/V (upper phase), using *p*-anisidine hydrochloride[3] as the spray reagent, revealed the presence of galactose, glucose, mannose, arabinose, xylose, rhamnose and reddish-brown spots due to uronic acids. Fractionation of the syrup on Whatman 3 MM paper in *n*-butanol : ethanol : water, 10 : 1 : 2, V/V and preparation of appropriate derivatives showed that glucose, galactose, mannose and xylose have D-configuration; while arabinose and rhamnose have L-configuration. Chromatographic examination in acidic solvents, *viz.*, ethyl acetate : pyridine : acetic acid : water, 5 : 5 : 1 : 3, V/V and *n*-butanol : acetic acid : water, 4 : 1 : 5, V/V (upper phase), revealed galacturonic and mannuronic acids. The two uronic acids were confirmed as D-galacturonic and D-mannuronic acids as follows:

The mucilage was subjected to partial hydrolysis with 1 N sulphuric acid for 3 hours on a boiling water-bath. After neutralization with barium carbonate, etc., the resulting syrup was fractionated on Whatman 3 MM paper using *n*-butanol : acetic acid : water, 4 : 1 : 5, V/V, to yield two uronic acid fractions I and II. Fraction I, $[\alpha]_D^{25} + 55°$ (*c*, 0·8 in water), was chromatographically pure and identical with standard galacturonic acid; its bromine water oxidation product had m.p. 212° and mixed m.p. 217°. Fraction II, $[\alpha]_D^{25} - 10°$ (*c*, 1 in water), was chromatographically pure and identical with standard mannuronic acid. Its lactone,[4] $[\alpha]_D^{25} + 94·8°$ (30 minutes; c, 0·84 in water), was converted into its 2, 4-dinitrophenylhydrazone,[5] m.p. 198-205° and mixed m.p. 200-204°.

The unusual feature of the mucilage is the presence of O-acetyl groups, lippids and D-mannuronic acid along with D-galacturonic acid. D-Mannuronic acid, so far, has been shown to be present in alginic acid from seaweeds[6] and exocellular acidic bacterial polysaccharides.[7,8]

The mucilage has been fractionated, using 0·05 N-hydrochloric acid, into a soluble uronic acid-pentosan-rich fraction and an insoluble hexosan-rich fraction. The composition of these two fractions is comparable to the cellulose containing seed mucilage of *Lepidium sativum* (Cress).[9]

Dept. of Post-Graduate Studies and Research in Chemistry,
Manasa Gangotri, Mysore-6,
September 5, 1969.

Y. V. Anjaneyalu.
R. N. Tharanathan.

---

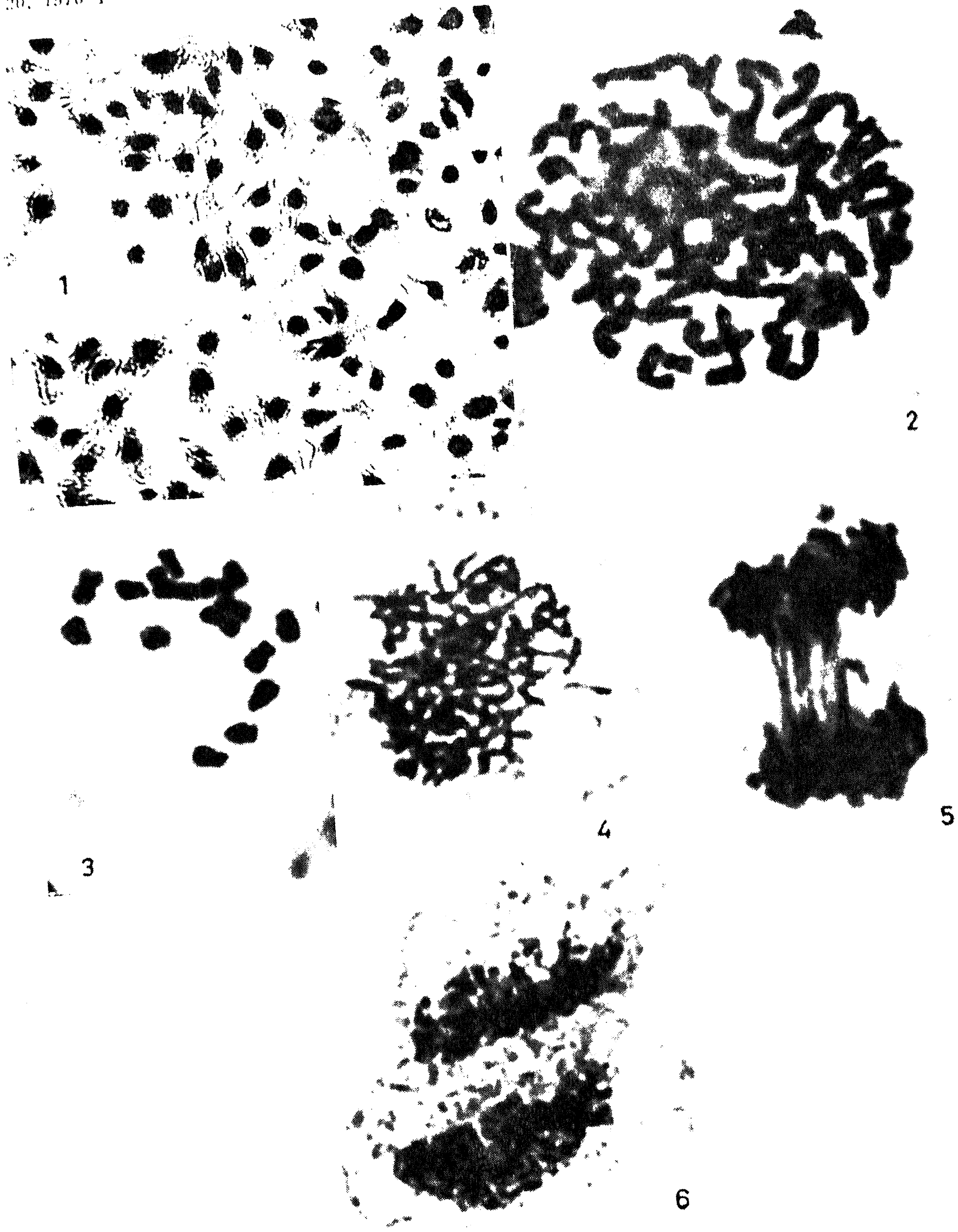
1. Adams, G. A. and Young, R., *Can. J. Chem.*, 1965, **43**, 2940.
2. Whistler, R. L. and Feather, M. S., *Methods Carbohydrate Chem.*, 1962, **1**, 464.
3. Hough, L., Jones, J. K. N. and Wadman, W. H., *J. Chem. Soc.*, 1950, p. 1702.
4. Linn, T. Y. and Hassid, W. Z., *J. Biol. Chem.*, 1966, **241**, 3282.
5. Whistler, R. L. and BeMiller, J. N., *Methods Carbohydrate Chem.*, 1963, **2**, 35.
6. Fischer, F. G. and Dörfel, H., *Z. Physiol. Chem.*, 1955, **302**, 186.
7. Gorin, P. A. J. and Spencer, J. F. T., *Can. J. Chem.*, 1966, **44**, 993.
8. Sharon, N., *Ann. Rev. Biochem.*, 1966, **35**, 492.
9. Tyler, J. M., *J. Chem. Soc.*, 1965, p. 5288.

A SIMPLE SQUASH TECHNIQUE FOR THE TISSUE CULTURES OF *TRIGONELLA FOENUM-GRAECUM* L.

Considerable difficulty was experienced in staining the chromosomes of cells from cultures of hypocotyl and apical root meristem of *T. fœnum-grœcum* L.[1] with aceto-carmine and aceto-orcein. There was a lack of contrast between the chromosomes and the cytoplasm. Material refractory to the above stains could often be stained with hæmatoxylin.[2] While the above technique gave crisp staining of the chromosomes of plants as well as animals,[3-8] it did not give an equally good contrast between the chromosomes and cytoplasm in plant cells grown *in vitro*. It was in this context that Harris' alum hæmatoxylin was found to be superior.

The procedure adopted was to transfer a piece of callus to a drop of the stain on a chemically cleaned slide, tease it thoroughly with needles, place a coverslip over it and then tap gently till the cells form a single layer. After removing the excess of stain with filter-paper strips, the preparation was sealed with paraffin. Forty-eight hours later, the temporary mounts were made permanent, employing Johansen's tertiary butyl alcohol method[9] or Conger and Fairchild's[10] quick freeze technique.

Pieces of calli fixed in acetic alcohol (1 : 3) for 24 hours could be stored in 70% alcohol and used as and when necessary. Such tissues rinsed well in distilled water and hydrolysed



PHOTOS 1-6

in N HCl at 60° C. for 8 minutes were handled as detailed earlier.

It was found that there was an intensification of the colour when the preparations were stored for 24 hours. The nuclei and chromosomes appeared bright red in the squashes. Photo 1 illustrates a region of a squash and emphasizes the contrast between the nuclei and the cytoplasm. Photos 2-6 are of mitotic stages.

Cytological investigations on plant tissues cultured *in vitro* have not kept pace with the rapid advances in our knowledge of plant cell culture and morphogenesis. White[11] commented: "The karyology of plant cell culture has hardly gotten beyond the aceto-carmine squash of 30 years ago" (p. 18). The technique described above could easily be adapted for cell cultures of plants other than *T. fœnum-græcum*.

Cytogenetics Lab., K. C. Gupta.
Dept. of Biochemistry, M. K. Subramaniam.
Indian Institute of Science,
Bangalore-12, *September* 2, 1969.

---

1. Subramaniam, M. K., Royan-Subramaniam, S., Gopinath, P. M., Gupta, K. C. and Vasantha, S., *Curr. Sci.*, 1968, **37**, 398.
2. Marimuthu, K. and Subramaniam, M K., *Ibid.*, 1960, **29**, 462.
3. Meenakshi, G. and Subramaniam, M. K., *Ibid.*, 1960, **29**, 438.
4. Subramaniam, M. K. and Subramanyam, S., *Ibid.*, 1961, **30**, 172.
5. Mangalangi, N. K. and Subramaniam, M. K., *Ibid.*, 1963, **32**, 364.
6. Gopinath, P. M. and Subramaniam, M. K., *Ibid.*, 1963, **32**, 169.
7. Elayidom, N. B., Royan-Subramaniam, S. and Subramaniam, M. K., *Ibid.*, 1963, **32**, 274.
8. Gupta, K. C., Royan-Subramaniam S. and Subramaniam, M. K., *Ibid.*, 1968, **37**, 319.
9. Johansen, D. A., *Plant Microtechnique*, McGraw-Hill, N.Y., 1940.
10. Conger, A. D. and Fairchild, L. M., *Stain Technol.*, 1953, **28**, 281.
11. White, P. R., *Seminar on Plant Cell Tissue and Organ Culture*. Delhi University, 1967, p. 12.

IRRADIATION-INDUCED ANEUPLOIDY AND ARCHITECTURAL ALTERATIONS OF CHROMOSOMES IN *CORIANDRUM SATIVUM* L.

Seeds of *Coriandrum sativum* L. were irradiated at 20,000 *r* and 25,000 *r* and sown in pots. One of the plants from seeds irradiated at 25,000 *r* was found to be a monosomic with $2n - 1 = 21$ (Figs. 3-5) while the chromosome number (Fig. 2) of *Coriandrum sativum* is $2n = 22$ (Grade and Grade, 1949).

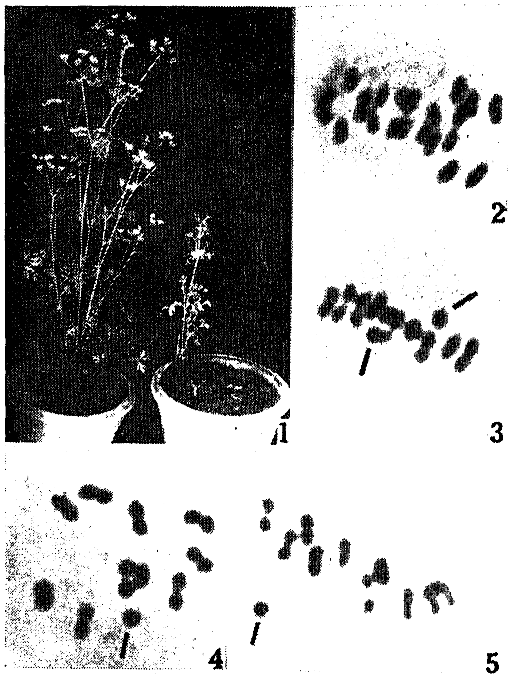
The monosomic was weak and smaller in height with less spread branches (Table I, Fig. 1), but had thick leaves.

Table I

Comparison of morphological characters of normal and monosomic plants

S. No.	Characters		Normal	Monosomic
1	Height of the plant in cm.	..	48	23
2	Spread of the plant in cm.	..	30	4
3	Length of the leaves in cm.	..	8	4
4	Length of the stomata in μ	..	225·42	236·38
5	Breadth of the stomata in μ	..	42·49	45·48
6	Length of the stomatal aperture in μ		138·77	146·41
7	Spread of the inflorescence in cm.		6	2

During meiosis, 21 chromosomes were clearly visible in PMCs. Out of these, 20 paired to form 10 bivalent, and one was left as univalent in each cell (Figs. 3-5). The behaviour of this univalent was erratic with regard to its orientation at metaphase plate and movement towards the poles. Besides loss of one chromosome, the irradiation had also caused reciprocal translocations in the chromosomes of this monosomic as indicated by the presence of multivalents (Fig. 3). The multivalents are present in the frequency of 0·4



Figs. 1-5. Fig. 1. Control and monosomic plants. Fig. 2. Metaphase I ($2n = 22$) in control. Figs. 3–5. Monosomic. Fig. 3. Metaphase I ($2n - 1 = 21$) showing I quadrivalent and 1 univalent. Fig. 4. Diakinesis showing 1 univalent and 10 bivalents. Fig. 5. Metaphase I showing 1 univalent and 10 bivalents

per cell with the variation of 0-1. The chiasma frequency of normal plant is 13·2 and of monosomic plant is 13·4 per cell.

Another interesting finding was the presence of variable shapes of pollen grains. The pollen shape in the controls is a radiosymmetric but in this monosomic, the pollen grains were triradiate and triangular, *i.e.*, Types E and F respectively, as reported by Joshi and Raghuvanshi (1965). The variable shapes of pollen grains appear to be caused by change in expression of gene(s) controlling pollen shape.

Seed-setting in this monosomic was very poor.

The authors are thankful to CSIR for financial support, to Professor S. C. Agarwala for laboratory facilities, and to Dr. Sheila Joshi for help.

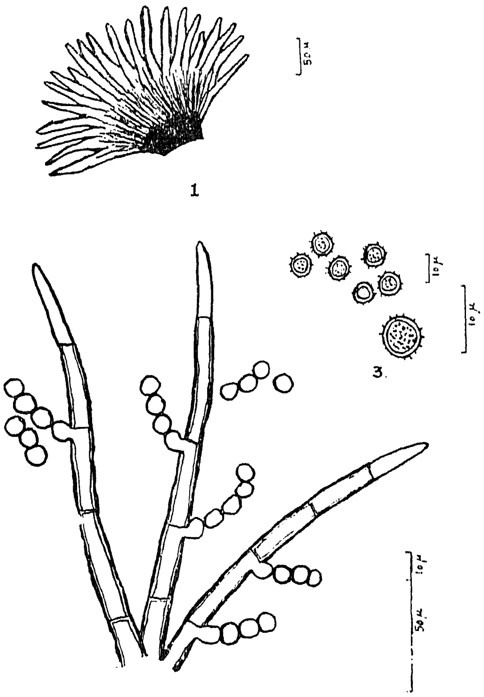
Cytogenetics Laboratory, S. S. RAGHUVANSHI.
Botany Department, A. K. S. CHAUHAN.
Lucknow University,
Lucknow, *September* 2, 1969.

---

1. Grade, A. and Grade, N., *Agron. Lusit.*, 1949, **11**, 91.
2. Sheila Joshi and Raghuvanshi, S. S., *Canad. Jour. of genet. and Cytol.*, 1965, **7** (2).

A NEW SPECIES OF *PERICONIA* FROM VARANASI, INDIA

DURING the course of investigation on saprophytic and parasitic fungi of *Uraria picta* Desv., a new species of *Periconia* was collected on the dead inflorescence of the above host, forming dark-brown colonies on the substratum. The detailed morphology of the fungus does not agree with any species already described by Mason and Ellis (1953) and Subramanian (1955). The present fungus shows some resemblance with *P. kambakkamensis*, Subramanian (1955), but can easily be distinguished from that on account of the following peculiarities: (*i*) unbranched stipe as against branched stipe in *P. kambakkamensis*, (*ii*) only apical tips of the stipe is sterile while in *P. kambakkamensis*, the apical tips as well as concolorous branches are sterile, (*iii*) length, width and number of septa in stipe, (*iv*) the conidia are produced laterally from basal as well as central cells of the stipe immediately below the septa, while in *P. kambakkamensis*, they are produced at the apex of short lateral fertile branches on the stipe, (*v*) conidia are dark-brown, finely verrucose and smaller as against pale to golden-brown, smooth and longer in *P. kambakkamensis*. Due to the above differences, the present fungus is being designated as *P. kashiensis* sp. nov.



FIGS. 1-3. Fig 1. Nature of the fungus. Fig. 2. Stipe with sterile sub-hyaline tips. Fig. 3. Conidia.

Periconia kashiensis sp. nov.—It forms dark-brown colonies on the substratum. When seen under lens, each colony consists of numerous conidiophores which are compactly aggregated and sterile above. Under the microscope, the lower part of the conidiophores becomes compacted and parallel to one another. The stipe is erect, unbranched, thick-walled upto 5-septate, 194·5 to 243·0 µ long and 4·0 to 5·0 µ broad, with sterile sub-hyaline tip. The sterile part of the stipe above the sporiferous region is 75·0 to 93·5 µ long. The sporogenous cells are produced laterally from basal as well as central cells of the stipe, immediately below the septa; pale to dark-brown, mostly globose, smooth and 4·5 to 5·0 µ in diameter. Conidia are produced acropetally in simple chains, dark-brown, globose, thick-walled, finely verrucose and 4·0 to 5·5 µ in diameter.

This fungus was collected in Varanasi on dead inflorescence of *Uraria picta* Desv. by S. D. Bharadwaj on 1-9-1968. Type material deposited in Mycol. Herb. Bot. Deptt., B.H.U., Varanasi.

Latin diagnosis.—Efformat colonias brunneas in substrato. Sub lente singulæ coloniæ constant et conidiophoris pluribue quæ sunt compacte aggregata et sterillia supra; submicroscopic pars inferior conidiophorum evadit compacta et inter se parallela. Stipes erectus non furcatus, parietibus crassis, ad quinquies septatus, 194·5-243·0 μ longus, 4·0-5·0 μ latus cum apice sterili subhyalino. Pars sterilis apicis supra regionem sporiferam 75·0-93·5 μ longa. Cellulæ sprogenæ lateraliter productæ e cellulis basalibus et mediis stiptitis immediate sub ipsis septis, pallide vel fusce brunneæ, vulgo globose, leves 4·5-5·0 μ diam. Conidia producta basifuga in catensis simplicibus, fusce brunnea, globosa, parietibus crassis pulchre verrucosis et 4·0-5·5 μ diam.

Lectus ad Varanasi in inflorescentia *Urericæ pictæ*, leg, S. D. Bharadwaj, et positus in Herb. Botany Deptt., B.H.U., Varanasi.

Our thanks are due to Prof. R. Misra for laboratory facilities, and to Rev. Fr. Dr. H. Santapau for the Latin diagnosis. The junior author is also thankful to the Director, P.G.I.M., B.H.U., for financial assistance.

Dept. of Botany, R. Y. Roy.
Banaras Hindu University, S. D. Bharadwaj.
Varanasi-5, *September* 5, 1969.

---

1. Mason, E. W. and Ellis, M. B., "British species of *Periconia*," *Mycol. Paper No.* 56, 1953.
2. Subramanian, C. V., "Some species of *Periconia* from India," *Jour. Indian Bot. Soc.*, 1955, **34**. 339.

ROOT-ROT OF *ARACHIS HYPOGAEA* SEEDLINGS CAUSED BY *PYTHIUM DEBARYANUM*

During January-February 1965, seedlings of *Arachis hypogœa* L. (groundnut) were found affected by root-rot caused by a species of *Pythium*. Serious incidence of the disease was observed in the same season of the subsequent years. A brief account of the disease is given below.

The disease manifested itself as water-soaked light-brown to brown lesions on the root near the hypocotyl region and later spread to the entire root system. The affected roots turned brown to dark-brown and subsequently the seedlings wilted. The causal organism was isolated in pure culture and maintained on oatmeal agar slants.

Hyphæ branched, 1·6-4 μ; sporangia spherical to elliptical, rarely with delicate beaks, terminal or intercalary, borne singly or in monochasial branches, 10-22 μ when spherical, 16-28 μ × 12-20 μ when elliptical, germinate either by germ-tubes or zoospores; zoospore reniform with two lateral flagella, 7-11 × 5-7 μ; encysted zoospores measure 6-8 μ.

Oogonia spherical, smooth, mostly terminal, rarely intercalary, 12-22 μ; antheridia usually 1-5 per oogonium, monoclinous and diclinous, clavate, terminal, making apical contact with oogonium; oospores smooth, spherical, aplerotic, 12-20 μ, with a single reserve globule and a refringent body. The fungus is identified as *Pythium debaryanum* Hesse.[2]

Pathogenicity of the organism was established on its natural host and it also infected *Brassica juncea* Coss., *B. oleracea* vari *botrytis* L., *Crotalaria juncea* L., *Cyamopsis tetragonoloba* (L.) Taub., *Phaseolus mungo* L.

Root-rot of *Arachis hypogœa* due to *Pythium ultimum* Trow has been reported from different countries.[3,4] Frezzi[1] reported that apart from *P. ultimum*, *P. irregulare* Buisman and *P. debaryanum* were also responsible for groundnut pod-rot in Argentina. In India *P. debaryanum* has not been reported on groundnut and this is the first report.

The author is grateful to Dr. G. Rangaswami, former Dean, for guidance and encouragement, and to Dr. N. N. Prasad, Faculty of Agriculture, Annamalai University, for critical perusal of the manuscript.

Microbiology and Plant V. Ragunathan.
Pathology Section,
Annamalai University,
Annamalainagar, Tamil Nadu,
September 5, 1969.

---

1. Frezzi, M. J., *Rev. Invest. Agric*, B. Aires, 1953. **10**, 113.
2. Middleton, J. T., *Mem. Torrey Bot. Club*, 1943, **20**, 1.
3 Wager, V. A., *Bothalia*, 1940, **4**, 3.
4. Wood, J. I. and Nance, N. W., *Plant. Dis. Repter. Suppl.*, 1938, **110**, 154.

ANTAGONISTIC ACTION OF BORON ON COPPER IN GROUNDNUT PLANT

Deficiency of boron alters a number of enzymatic reactions,[1] although it was not a constituent of any enzyme nor was indispensable for their action. The present study was made to find out the biochemical nature of B-toxicity on copper and copper-protein enzymes in the leaves of groundnut, *Arachis hypogœa* L. var. TMV-2.

The sand culture technique for growing the plants, other experimental procedures and 10 p.p.m. boron treatment were the same as used by Gopal.[2] After boron treatment was started, the mature leaves from middle of the stem from individual plants of both the control (0·5 p.p.m. boron in nutrient solution) and treated sets were sampled once every two days and continued upto 12 days (including an initial sampling before excess B-treatment). At each time of sampling, the leaves were analysed for their boron[3] and copper[4] spectrophotometrically. The activities of ascorbic acid oxidase and polyphenol oxidase were assayed titrimetrically.[5] The results are presented in Table I.

A definite decrease in the activities of the two copper-protein enzymes was observed in the leaves of plants supplied with toxic boron level. The inhibition of the enzyme activities may be an indirect effect associated with a decrease in the copper content or due to the overall adverse effect leading to the disintegration or impaired activity of cytoplasmic proteins associated with an accumulation of abnormally high concentrations of boron in the chlorotic leaves. The experimental evidence and theoretical concepts on the nature of antagonism between B and Cu in plants were discussed by MacVicar and Burris[6] and Ramamoorthy.[7] The present results on the effect of B-toxicity on the enzyme systems of copper indicates the mode of antagonism between boron and copper in plant cells.

TABLE I

Effect of boron on copper and activities of copper-protein enzymes in the middle leaves of Arachis hypogaea *(Mean of three replications)*

Days after 10 p.p.m. boron treatment	Control (0·5 p.p.m. boron)[A]				Treated (10 p.p.m. boron)[A]			
	Boron*	Copper*	Ascorbic acid oxidase†	Polyphenol oxidase†	Boron*	Copper*	Ascorbic acid oxidase†	Polyphenol oxidase†
0‡	110 ± 4	20 ± 1	3·4 ± 0·2	23·0 ± 0·4	106 ± 6	21 ± 1	3·5 ± 0·2	23·1 ± 0·4
2	121 ± 3	21 ± 1	4·4 ± 0·3	31·0 ± 0·6	1230 ± 40	19 ± 1	1·7 ± 0·4	30·2 ± 0·6
4	124 ± 4	20 ± 2	3·6 ± 0·2	28·1 ± 0·6	2022 ± 44	19 ± 1	1·9 ± 0·3	14·9 ± 0·6
6	106 ± 5	20 ± 1	3·6 ± 0·2	24·5 ± 0·4	2394 ± 30	18 ± 2	1·8 ± 0·1	14·6 ± 0·8
8	100 ± 6	21 ± 1	5·1 ± 0·2	30·0 ± 0·6	2869 ± 64	18 ± 2	1·8 ± 0·2	22·4 ± 0·4
10	108 ± 4	21 ± 2	5·6 ± 0·2	31·4 ± 0·6	3220 ± 36	17 ± 1	2·3 ± 0·4	21·2 ± 0·8
12	110 ± 6	21 ± 1	6·1 ± 0·4	30·2 ± 0·5	3910 ± 86	17 ± 1	2·0 ± 0·2	20·6 ± 0·6

[A] Both the control and treated plants were supplied with 0·02 p.p.m. copper as copper sulphate in nutrient solution. * Values expressed in $\mu g/g$ or p.p.m. on oven dry weight. † Ascorbic acid oxidase and polyphenol oxidase activities expressed in mg. ascorbic acid oxidized/g. fresh weight in 30 min. ‡ Analyses made before 10 p.p.m. boron treatment.

With increase in the accumulation of boron in leaves, the B-toxicity symptoms such as chlorosis (yellowing) gradually intensified and later (10 days after treatment) necrosis manifested. There was not much variation in the B-content of the leaves in control plants in the experimental period. In treated plants, the boron content quickly increased in the leaves and it was 3,910 p.p.m., 12 days after treatment. The copper content of the leaves of control plants ranged from 20 to 21 p.p.m., and it was lowered by 19%, 12 days after B-treatment against respective control.

The activities of ascorbic acid oxidase and polyphenol oxidase in the leaves of control plants showed some fluctuation; however, they were either equal to the initial values or increased slightly by the end of 12 days. Ascorbic acid oxidase activity was relatively lower than the polyphenol oxidase. With B-treatment, the activity of ascorbic acid oxidase was much lowered than polyphenol oxidase; by 12 days after treatment, it was only 33%, whereas the activity of polyphenol oxidase decreased to 68% over respective controls.

I thank Prof. I. M. Rao (retired) for encouragement.

Dept. of Botany, N. H. GOPAL.*
S.V. University,
Tirupati (A.P.), *September* 8, 1969.

---

* Present address: Central Coffee Research Institute, C.R.S. P.O.; Chikmagalur, Mysore State.

1. Skok, J., In *Trace Elements*, (C. A. Lamb, O. G. Bentley, and J. M. Beattie ed.), Academic Press, Inc., 1958, p. 227.
2. Gopal, N. H., *Indian J. Exp. Biol.*, 1969, **7**, 187.
3. Dible, W. T., Truog, E. and Berger, K. C., *Anal. Chem.*, 1954, **26**, 418.
4. Cheng, K. L. and Bray, R. H., *Ibid.*, 1953, **25**, 655.
5. Povolotskaya, K. L. and Sedenko, D. M., *Biokhimiya*, 1956, **21**, 133.
6. MacVicar, R. and Burris, R. H., *Arch. Biochem.*, 1948, **17**, 31.
7. Ramamoorthy, B., *Symp. Trace Elements*, *Nat. Inst. Sci. Ind. Bull.*, 1953, **8**, 9.

REVERSAL OF N-BENZYL ORTHOFLUOROPHENOXY ACETAMIDE-INDUCED HYPOCOTYL INHIBITION BY GIBBERELLIC ACID

FLUORINE-SUBSTITUTED phenoxy derivatives have recently been reported to be novel growth inhibitors.[1,2] Like other growth inhibitors,[3] these chemicals also inhibit growth of the seedlings. Gibberellic acid has been reported to antagonise effects of growth inhibitors.[4-10] So, it was interesting to study the interaction of GA_3 on N-benzyl orthofluorophenoxy acetamide-induced inhibition on the growth of *Cyamopsis tetragonoloba* seedlings.

The seeds of *Cyamopsis tetragonoloba* were allowed to germinate in petri dishes having two layers of filter-papers moistened with different concentrations of the test solution, *i.e.*, N-benzyl orthofluorophenoxy acetamide and gibberellic acid either separately or mixed together in different proportions. Water control was also run simultaneously.

The results are shown in Table I. Gibberellic acid alone at a concentration of 10 p.p.m. doubled the hypocotyl elongation (Fig. 1). N-benzyl orthofluorophenoxy acetamide inhibited the growth of the radicle when applied at a concentration of 25 p.p.m. to an extent of 93·1% and the hypocotyl 46·4% in comparison to water control. Gibberellic acid (10 p.p.m.) and N-benzyl orthofluorophenoxy acetamide (25 p.p.m.) when applied together hypocotyl showed 32·8% more growth in comparison to water control.

TABLE I

Conc. of GA_3 in p.p m.	Conc. of N-benzyl orthofluoro-phenoxy acetamide in p.p m.	Percentage inhibition (−) or promotion (+) over the water control on V day	
		Hypocotyl	Radicle
10	0	+94·34	+27·4
0	25	−46·4	−93·1
10	25	+32·8	−92·7
0	10	− 9·6	−85·8
10	10	+36·3	−80·5

The growth inhibitory mechanism of N-benzyl orthofluorophenoxy acetamide appears to be different in hypocotyl and the radicle. The inhibitory system operative in hypocotyl is reversible by gibberellic acid. The site of the action of the inhibitory action in the radicle completely remains unaffected. The growth-promoting action of GA_3 also appears to be selective in the hypocotyl and the radicle, the former being reversed by N-benzyl orthofluorophenoxy acetamide.

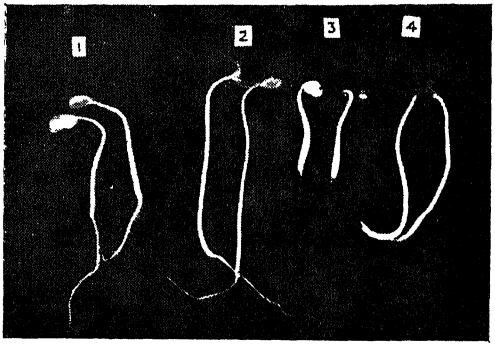


FIG. 1. Growth of the seedlings of *Cyamopsis tetragonoloba* after five days of germination. 1. Control; 2. GA_3 (10 p.p.m.); 3. N-Benzyl orthofluorophenoxy acetamide (25 p.p.m.); 4. GA_3 (10 p.p.m.) *plus* N-Benzyl orthofluorophenoxy acetamide (25 p.p.m.).

Financial assistance from C.S.I.R. is gratefully acknowledged.

Lab. of Tissue Culture and Biochemistry,
Botany Dept., The University,
Jodhpur, India, *September* 9, 1969.

SHYAM KATHJU.
M. N. TEWARI.

---

1. Tewari, M, N., *Curr. Sci.*, 1968, **37**, 236.
2. —, *Experientia*, 1969, **25**, 433.
3. Cathey, H. M., *Ann. Rev. Plant Physiol.*, 1964, **15**, 271.
4. —, *Photoperiodism and Related Phenomenon in Plants and Animals*, 1959.
5. Halevy, A. H., *Experientia*, 1962, **18**, 74.
6. —, *Bull. Res. Council Israel*, 1962, **11 D**, 83.
7. Monselise, S. P. and Halevy, A. H., *Amer. J. Bot.*, 1962, **49**, 405.
8. Sachs, R. M., Lang, A., Beretz, C. F. and Roach, J., *Ibid*, 1960, **46**, 260.
9. Halevy, A. H. and Monselise, S. P., *φyton*, 1963, **20**, 79.
10. —, *J. Exp. Bot.*, 1964, **15**, 546.

REVIEWS AND NOTICES OF BOOKS

Elasticity in Engineering. By Ernest E. Sechler. (Dover Publications, Inc., 180, Varick Street, New York, N.Y. 10014, U.S.A.), 1968. Pp. ix + 419. Price $3.50.

This Dover edition, first published in 1963, is an unabridged and corrected republication of the work originally published by John Wiley and Sons, Inc., in 1952.

The first section of the book establishes the equations and assumptions underlying elasticity. In these seven chapters are collected the basic equations in Cartesian, cylindrical, and spherical co-ordinates which are necessary for the solution of elastic problems. By application of these fundamental equations, the solution of any specific structural problem can be obtained. The second section, therefore, illustrates this applicability in the solution of problems of stable structures, and the third section deals with problems of instable structures.

Within the last two sections, Professor Sechler obtains solutions either by the rigorous application of the fundamental equations of elasticity or by types of approximate solutions; mathematical methods of matrix and tensor analysis are not included. Twenty-three worked examples and over 150 class-room or study problems illustrate the principles covered.

Written primarily for engineers working in structural analysis, this book is of great value in undergraduate and graduate courses in applied elasticity and advanced strength of materials.

C. V. R.

Chemical Reaction Engineering. *An Introduction to the Design of Chemical Reactors.* By Octave Levenspiel. (Wiley Eastern Private Limited, Publishers, J-41, South Extension, New Delhi-3), 1969. Pp. xv + 501. Price Rs. 21·00.

This book has been published with the assistance of the Joint Indian-American Text-Book Programme.

The primary concern in Chemical Reaction Engineering is to decide which of the many possible alternative reactor designs is optimum. This book treats the major reactor types side by side allowing comparison of their performance capabilities—a procedure which develops the understanding and good judgment necessary for making this decision. The book stresses teachability and emphasizes the strategy of design common to all systems rather than distinct approaches and complex applications.

The chapters contained in this book are: Introduction; Kinetics of Homogeneous Reactions, Interpretation of Batch Reactor Data; Introduction to Reactor Design; Single Ideal Reactors; Design for Single Reactions; Design for Multiple Reactions; Temperature and Pressure Effects; Non-ideal Flow; Mixing of Fluids; Introduction to Design for Heterogeneous Systems; Non-catalytic Fluid-Solid Reactions; Heterogeneous Fluid-Fluid Reactions; and Solid Catalyzed Fluid Reaction.

This book will serve as a useful guide to the design engineer and as a valuable teaching tool for presenting chemical reactor design on the undergraduate as well as the graduate level.

C. V. R.

Fundamentals of Statistics. By Mulholland and C. R. Jones. (Plenum Press, New York), 1968. Pp. x + 291. Price $5.95.

This book is intended primarily for the use of students studying for the General Certificate of Education at Advanced Level, for Higher National Certificates in Mechanical or Electrical Engineering, Mathematics, Chemistry, Biology or Pharmacy, or for a University or Technical College (C.N.A.A.) degree in any of the subjects mentioned. It could also be used as a good basis for any introductory statistics course.

The contents of the book are: Introduction; The Collection, Organization and Representation of Numerical Data; Elementary Probability; The Binomial and Poisson Distributions; Measures of Central Tendency; Measures of Dispersion, Continuous Distributions; The Normal Distribution; Significance Testing and Confidence Intervals; Quality Control; Chi-Squared Distribution; The F Distribution (Variance Ratio); Bivariate Distributions; Mathematical Expectation, Variance and Covariance; and Weighted Averages, Death Rates and Time Series.

C. V. R.

Kinetics and Mechanisms of Polymerization (Vol. 2). *Ring-Opening Polymerization.* Edited by Kurt C. Frisch and Sidney L. Reegen. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 528. Price $ 28.50.

This is the second volume of a three-volume treatise on the kinetics and mechanisms of polymerization reactions. This volume deals with ring-opening polymerizations.

The polymerization of cyclic monomers has become increasingly important to large segments of the chemical and polymer industries. Hence, it is necessary to further the understanding of these reactions by making available the details of their kinetics and mechanisms. This volume represents an effort at compiling the available significant data and theories into one comprehensive volume.

The chapters contained in this volume are: Introduction, by K. C. Frisch and S. L. Reegen; 1, 2 Epoxides, by Y. Ishii and S. Sakai; 1, 3 Epoxides and Higher Epoxides, by P. Dreyfuss and M. P. Ereyfuss; Cyclic Formals, by Junji Furukawa and Koichi Tada; Cyclic Sulfides, by P. Sigwalt; Alkylenimines, by M. Hauser; Lactones, by R. D. Lundberg and E. F. Cox; Lactams, by H. K. Reimschuessel; Cyclic Siloxanes and Silananes, by E. E. Bostick; Nitrogen-Containing Heterocyclic Compounds, by V. A. Kargin and V. A. Kabanov; and N-Carboxy-α-Amino-Acid Anhydrides, by Y. Shalitin.

This book will serve not only as reference material for past investigations of the kinetics and mechanisms of ring-opening polymerizations, but may also act as a stimulant for future research work of fundamental aspects of these polymerization reactions. C. V. R.

Statics for the Biological Sciences. By W. C. Schefler. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W. 1, England), 1969. Pp. 232. Price 65 *sh.*

The book is specially addressed to biology students who are generally apt to feel shy of mathematics. In the treatment, rigorous mathematics is avoided, but basic principles are clearly explained and statistical concepts are discussed more from a logical or intuitive point of view.

The book deals in the first few chapters with normal distribution, probability, principles and uses of inference, hypothesis testing, student's *t*-distribution, chi-square and Poisson's distributions. The other chapters are devoted to practical applications. Problems of interest to biology students are given at the end of each chapter. A. S. G.

An Introduction to Fishing Gear Technology. By K. B. Lal. (Metropolitan Book Company Pvt. Ltd., Netaji Subhash Marg, Delhi-6). Pp. 229. Price Rs. 16, $ 3.50 or 30 *sh.*

The author has collected considerable information on fishing gear technology and presented it in a compact and readable form to be of practical value. The first three chapters are of a general type and deal with the nature of the fishing gear in use all over. The following six chapters are devoted to gear materials, their fabrication, preservation, etc. Relevant data on the various properties of these materials are given as 45 tables in the Appendix. The last two chapters deal with standardisation and developmental possibilities. Being a compilation of useful information, the book is void of illustrations. A. S. G.

Books Received

Tropical Agriculture Series—YAMS. By D. G. Coursey. (Longmans Green & Co. Ltd., 48, Grosvenor Street, London W. 1), 1969. Pp. xiv + 230. Price 63 *sh.*

Physical Methods in Macromolecular Chemistry, Vol. I. Edited by Benjamin Carroll. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1969. Pp. x + 385. Price $ 17.75.

A Programmed Course in Algebra. By A. C. Newborn. (Addison Wesley Pub. Co., Inc., West End House, 11, Hills Place, London W. 1), 1969. Pp. xvii + 630. Price 43 *sh.*

Statistics for the Biological Sciences. By W. C. Schefler. (Addison Wesley Pub. Co., Inc., West End House, 11, Hills Place, London W. 1), 1969. Pp. 231. Price 65 *sh.*

The Development of Chemical Principles. By C. H. Langford and R. A. Beebe. (Addison-Wesley Pub. Co., Inc., West End House, 11, Hills Place, London W. 1), 1969. Pp. 384. Price 52 *sh.*

Transition Metal Chemistry—A Series of Advances. (Vol. 5). Edited by R. L. Carlin. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1969. Pp. x + 305. Price $ 15.75.

1743–70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

DETERMINATION OF NEPTUNIUM-239 FROM FALLOUT SAMPLES

R. N. KHANDEKAR AND SMT. S. B. SANTANI

Air Monitoring Section, Health Physics Division, Bhabha Atomic Research Centre, Bombay, India

ABSTRACT

An analytical procedure is described for the separation of neptunium-239 from fallout samples. Neptunium is separated from uranium, plutonium and fission products by solvent extraction method. Np (IV) is extracted from 1 M nitric acid by shaking with equal volume of 0·5 M thenoyl-tri-fluoro acetone (T.T.A.) solution in xylene and back-extracted with 8 M nitric acid. Finally, Np is co-precipitated with zirconium mandelate, and counted in a low background beta-counting set-up. The average chemical recovery by this procedure is 82·6%. Under the conditions described, very good separation of neptunium is effected from aluminium, iron, fission products, thorium, uranium and plutonium.

1. INTRODUCTION

NEPTUNIUM-239 is one of the important isotopes in the early fallout from the nuclear weapon tests. It is produced by the interaction of neutrons with the uranium used in the weapon, by (n, γ) reaction. The neutron capture cross-section for this reaction is fairly large and therefore the Np^{239} is present in large quantities in the fresh fallout. The rapid determination of Np^{239} in the presence of fission products, uranium and plutonium. requires a quantitative chemical separation from these elements and generally solvent extraction methods are advantageous for such analyses.

Magnusson *et al.*[1] studied the extraction of neptunium from hydrochloric acid solution by thenoyl-tri-fluoro acetone (T.T.A.) and determined the distribution coefficients for neptunium as a function of acidity and valence state. Moore[2] demonstrated the possibility of quantitative extraction of Np (IV) with T.T.A. from nitric acid solution. The procedure described by Moore was tried for the fallout samples but it did not give consistent chemical recovery of Np^{239}. This was presumably due to incomplete reduction of neptunium to the fourth valence state or due to a change in the sample matrix. For a complete reduction of neptunium to the fourth valence state a combination of hydroxylamine hydrochloride and ferrous sulphamate was found more suitable. Fallout samples contain varying amounts of silica and iron, and as these elements interfere in the extraction of neptunium, one has to take special care during the chemical analysis.

Present paper gives the analytical procedure for the separation of Np^{239} from fallout samples. The separated neptunium is completely free from uranium and fission products,

2. EXPERIMENTAL

Sample Preparation.—(*i*) The high altitude dust samples are collected from the surfaces of commercial aircrafts. The various parts of the aircraft are swiped with cotton wool soaked in white petrol. After gamma-spectral analysis, the samples are leached with a mixture of 3 M hydrochloric acid and 0·1 M hydrofluoric acid. More than 95% radioactivity gets leached by this leaching mixture.[3] The leached solution is made to a definite volume and known amounts of inactive carriers like Sr, Cs, Zr, Ce and Ru are added to it.

(*ii*) Rain-water samples are evaporated to dryness and the residue is leached in the same way as swipe samples.

(*iii*) Air filter samples are leached directly with the same leaching mixture as above.

Chemical Procedure and Results.—A suitable aliquot of the leached solution is taken for the neptunium analysis with 5 mg. of iron carrier. 1·0 gm. of hydroxylamine hydrochloride, boric acid + nitric acid mixture are added to the solution. The solution is then warmed and ammonium hydroxide is added slowly to the solution to precipitate hydroxides. The hydroxide precipitate is dissolved in dilute nitric acid and the solution is evaporated to dryness. (If silicic acid appeared while evaporating, it should be centrifuged in the presence of hot concentrated nitric acid to avoid the losses of neptunium due to adsorption on silicic acid. Silicic acid also interferes in the extraction of neptunium in the next steps.) The residue is then dissolved in 15 ml. of 1 N nitric acid and 0·25 gm. of hydroxylamine hydrochloride are added to it. The solution is warmed for ten minutes and 2 ml. of 3 M ferrous sulphamate are added to it. After cooling to room temperature the solution is transferred to a 50 ml, separating funnel. Neptunium is extracted from this solution by shaking with equal volume of 0·5 M thenoyl-tri-fluoro acetone (T.T.A.) in xylene for ten minutes. The two layers are allowed to separate and the aqueous phase is transferred to another separating funnel and neptunium is extracted in the same way. Both the organic phases are collected together in another 100 ml. separating funnel and scrubbed with an equal volume of 1 M nitric acid for one minute. Neptunium is back-extracted from the organic phase by shaking it with equal volume of 8 M nitric acid for four minutes. The phases are separated. The aqueous phase is evaporated to dryness and the residue is taken in 10 ml. of 1 M HNO_3. 2 ml. of ferrous sulphamate are added to the solution with 5 mgm. of inactive zirconium carrier. The solution is kept for five minutes and then neptunium is co-precipitated with zirconium-mandelate by adding mandelic acid to the solution is kept for five minutes and then neptu-20 mm. diameter filtering stick, and the precipitate is mounted on special perspex planchet for counting in a low background beta-counter.

The procedure is checked by tracer experiments in which known amounts of Np^{239} tracer were added to old fallout samples. These samples were analysed for neptunium, using the above procedure to determine the chemical recovery and also the radiochemical purity of neptunium. Table I gives the percentage recovery of neptunium. The data in Table I show that there is not much variation in the chemical recovery of neptunium. The average chemical yield is 82·6%. Figures 1 and 2 respectively show the decay curve and gamma-ray spectrum of neptunium-239, separated from the fallout debris collected after a recent Chinese nuclear test (10th Chinese test). The above figures show that the radiochemical purity of separated neptunium is excellent.

TABLE I

Recovery of Np^{239} from fallout samples

No.	d.p.m. of Np^{239} added	d.p.m. of Np^{239} recovered	% recovery
1	770	642	83·4
2	770	623	80·9
3	770	654	84·9
4	185	151	81·6
5	185	152	82·2
		Av.	82·6

In some cases where concentrations of Np^{239} in the sample is small and that of Zr^{95} is high, a small quantity of radio-zicronium may follow the neptunium in the final stripping solution (*i.e.*, 8 M HNO_3). This small amount of radio-zirconium in the final stripping solution can be removed by performing a five minutes extraction of stripping solution with equal volume of 0·5 M T.T.A. in xylene. Neptunium remains quantitatively in aqueous phase.

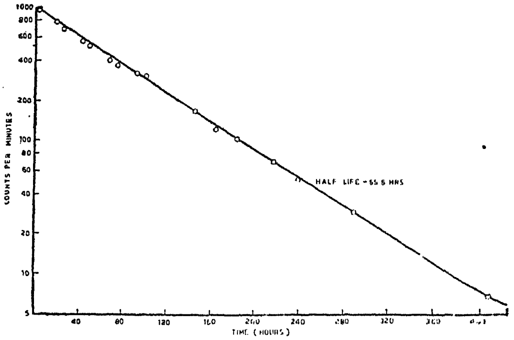


FIG. 1. Decay curve of neptunium-239 separated from fallout debris collected after the tenth Chinese Nuclear Test.

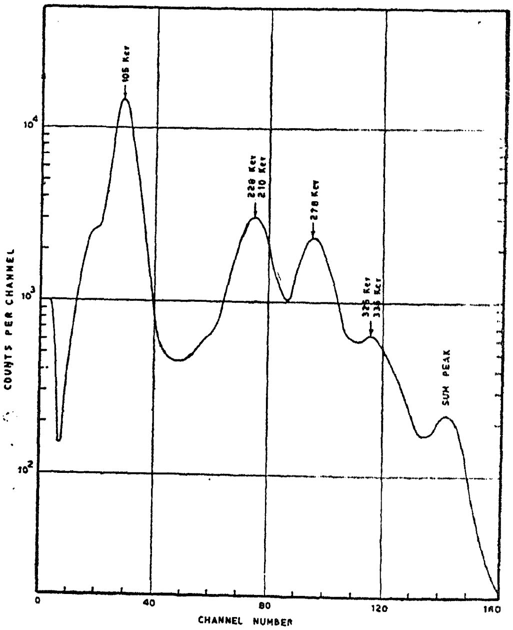


FIG. 2. Gamma-spectrum of neptunium-239 from the sample collected after the tenth Chinese Nuclear Test.

The co-precipitation of neptunium (IV) with zirconium mandelate is also studied using Np^{239} tracer. Data in Table II show that the co-precipitation of neptunium with zirconium mandelate is quantitative. The co-precipitation of Np (IV) with zirconium mandelate in the final step is more convenient for counting the beta-activity of Np^{239}.

TABLE II

Co-precipitation of Np^{239} with Zr-mandelate

No.	c.p.m. of Np^{239} added	c.p.m. of Np^{239} carried with Zr-mandelate
1	925	915
2	1063	1060
3	808	810
4	1320	1305

ACKNOWLEDGEMENTS

The authors gratefully thank Dr. K. G. Vohra, Head, Air Monitoring Section, for his keen interest and encouragement in the course of this work. Thanks are also due to Shri B. Y. Lalit for his help in beta-activity measurements.

---

1. Magnusson, L. B., Hindman, J. C. and Jachapelle, T. J., *Chemical Methods for the Purification and Isolation of Neptunium*, Argonne National Laboratory, ANL-4066, October, 1947.
2. Moore, F. L., *Anal. Chem.*, 1957, **29**, 941.
3. Boni, A. L., *Ibid.*, 1960, **32**, 559.
4. Moore, F. L. and Hudgens, J. E. Jr., *Ibid.*, 1957, **29**, 1767.
5. —, *Symposium on Solvent Extraction in Analysis of Metals*, A.S.T.M. Special Technical Publication No. 238, 1958, p. 13.

X-RAY PATTERNS OF MOLLUSC SHELLS FROM INDIAN WATERS

RAMESH NARAYAN

Department of Physics, Madras Christian College, Tambaram, Madras-59

1. MATERIALS

It is well known that the shells of molluscs consist of layers of calcium carbonate interspersed with protein layers and that the calcium carbonate occurs mostly as calcite or aragonite, and more rarely as vaterite.[1] Some studies have been made on this subject and are summarised by Jean Bouillon.[2] These, however, appear to have been made on specimens obtained from the temperate latitudes. The author is not aware of any reports of X-ray studies of the nature of the inorganic component in mollusc shells occurring in Indian waters. A study was therefore made of the X-ray diffraction patterns of a number of typical specimens obtained from the beaches of Madras State. The specimens studied are listed serially in Table I giving their class, sub-class (if any), order, family and genus. A fair number of specimens contained in this list have also been studied by Jean Bouillon.[2] These are indicated by a mark (√) in Table I.

TABLE I

List of the shells studied with their identifications

- Class—Gastropoda
- Sub-class—Prosobranchia
  - (A) Order—Megagastropoda
    - (*a*) Series—Strombacea
      - Specimens 1 and 2 Strombidae, *Strombus* (A) (Two different species)
    - (*b*) Series Cypraeacea
      - Specimens 3 and 4 Cypraeidae, *Cyprea* (A) √(Two different species)
    - (*c*) Series—Cerithiacea
      - Specimen 5—Turritellidae, *Turritella* (A)√
  - (B) Order—Stenoglossa
    - (*a*) Series—Buccinacea
      - Specimen 6—Volemidae, *Hemifuscus*(A)
      - Specimen 7—Fasciolariidae, *Fasciolaria* (A)
  - (C) Order—Archaeogastropoda
    - (*a*) Series—Zeugobranchia
      - Specimen 8—Haliotidae, *Haliotis* (A)
    - (*b*) Series—Trochacea
      - Specimen 9—Trochidae, *Trochus* (A)
    - (*c*) Series—Patellacea
      - Specimen 10—Patellidae, *Patella* (C)√
- Class—Lamellibranchiata
  - (A) Order—Eulamellibranchiata
    - Sub-Order—Heterodonta
      - (*a*) Series—Veneracea
        - Specimen 11—Veneridae, *Meretrix*(A)
    - Sub-Order—Schizodonta
      - (*a*) Series—Unionacea
        - Specimen 12—Unionidae, Unioninae, *Lamellidens* (A)
  - (B) Order—Anisomyaria
    - (*a*) Series—Pectinacea
      - Specimen 13—Pectinidae, Spondilinae, *Spondylus* (C)√
- Class—Cephalopoda
- Sub-Class—Tetrabranchiata
- Order—Nautiloidea
  - Specimen 14—Nautilidae, *Nautilus* (A)√

(C) = Calcite; (A) = Aragonite; √ = Also listed in Ref. 2.

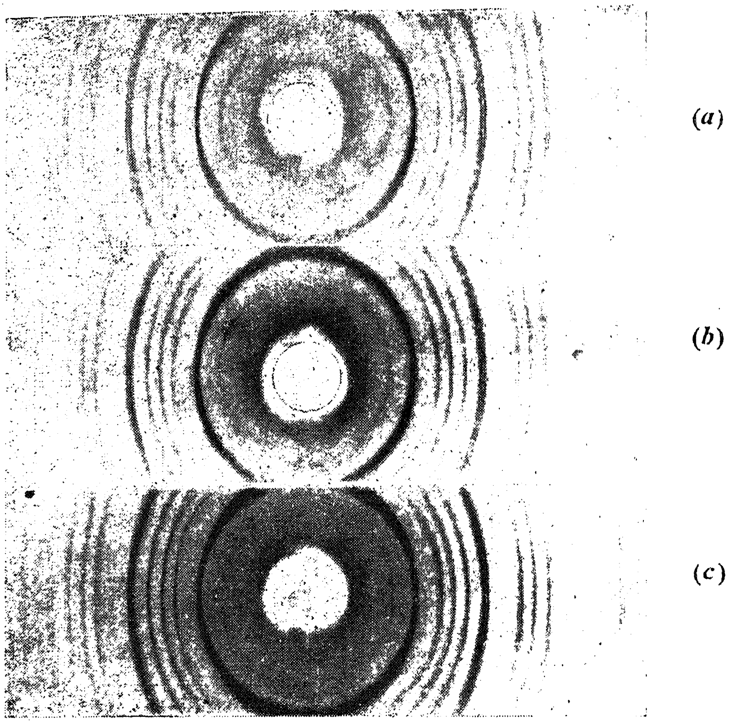


FIG. 1. X-ray diffraction patterns of specimens showing a typical calcite pattern. (a) Mineral specimen. (b) Shell No 13. (c) Hen egg shell.

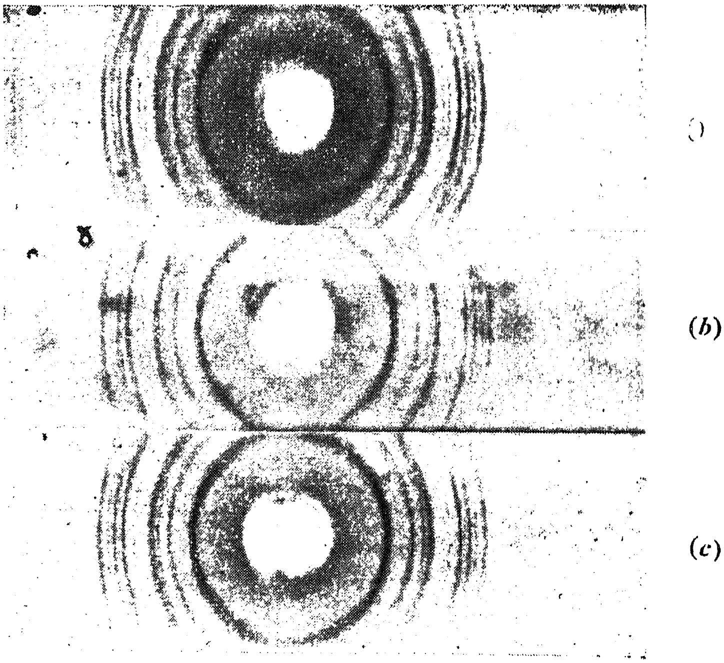


FIG. 2. X-ray diffraction patterns of specimens showing a typical aragonite pattern: (a) Mineral specimen. (b) Shell No. 1. (c) Coral specimen.

However, it is not known whether the actual species under the particular genus which has been studied are the same in both studies (Bouillon also has not listed the name of the species). All the specimens belong to the phylum Mollusca. The results of the studies are reported below. As a part of the study two non-mollusc specimens, namely, a coral (phylum-Coelenterata) and a hen egg-shell were also studied.

2. Method and Results

The X-ray patterns were taken with a Philips 57·3 mm. powder camera using copper Kα radiation. Figures 1 and 2 give typical examples of the patterns recorded. The spacings of the lines observed in the powder patterns of all the mollusc specimens along with the visually estimated relative intensities. are shown is Tables II A and II B. The measured data of the first few lines down to a spacing of about 1·9 Å are listed. The first two columns in each table contain the standard spacings and intensities, as reported in the A.S.T.M. Index for calcite and aragonite respectively. The measurements reported in Columns 3 and 4 on a standard mineral specimen show the accuracy that may be expected from the experiments. It will be seen that the specimens in each group contain almost exclusively one inorganic compound, namely, either calcite or aragonite. From the fact that no powder lines other than those of the identified components are recorded in the patterns, the author estimates that, if at all the other polymorphs of calcium carbonate exist in the shells studied, they form less than 50% of the prominent material of the shell. Only in the case of specimen 9 is a faint trace of the strongest line of calcite ($d = 3{\cdot}04$ Å) found among the powder lines of aragonite (*see* Table II B).

Table II

Measured data on the X-ray diffraction patterns

A. Calcite patterns

Ring number	A.S.T.M. Index		Calcite mineral		Specimen 10		Specimen 13	
	d (Å)	Int.	d (Å)	Int.	d (Å)	Int.	d (Å)	Int.
1	3·86	12	3·86	w	4·04	w	3·86	w
2	3·04	100	3·03	vs	3·15	vs	3·05	vs
3	2·85	3	2·82	vw	..	..	..	..
4	2·50	14	2·49	s	2·60	m	2·49	m
5	2·29	18	2·28	s	2·37	m	2·30	m
6	2·10	18	2·09	s	2·16	m	2·10	m
7	1·93	5	..	..	..	..	..	..
8	1·91	17	1·91	s	1·97	m	1·93	m
9	1·88	17	1·84	s	1·93	m	1·83	m

B. Aragonite patterns

Ring number	A.S.T.M. Index		Aragonite mineral		Specimen 1		Specimen 2	
	d (Å)	Int.	d (Å)	Int.	d (Å)	Int	d (Å)	Int.
1	4·21	2	..	..	..	..	..	..
2	3·40	100	3·44	vs	3·43	vs	3·43	vs
3	3·27	52			3·28	s	3·24	m
4	2·87	4	..	..	..	..	..	..
5	2·73	9	..	..	..	..	..	..
6	2·70	46	2·77	s	2·73	s	2·74	s
7	2·48	33	2·54	m	2·51	m	2·50	m
8	2·41	14	..	..	..	..	..	..
9	2·37	38	2·42	s	2·39	m	2·38	s
10	2·34	31			2·35	m		
11	2·33	6	..	..	..	..	..	..
12	2·19	11	2·24	w	2·21	vw	2·20	vw
13	2·11	23	2·16	w	2·13	w	2·13	w
14	1·98	65	2·03	s	2·00	s	1·99	s
15	1·89	32	1·93	m	1·90	m	1·90	m

TABLE II—*contd.*

B. Aragonite Patterns (*Contd.*)

Ring number	Specimen 3		Specimen 4		Specimen 5		Specimen 6		Specimen 7	
	d (Å)	Int.	*d* (Å)	Int.	*d* (Å)	Int.	*d* (Å)	Int.	*d* (Å)	Int.
1	..	..	..	..	..	..	..	..	..	..
2 } 3 }	3·37	vs	3·33	vs	3·45	vs	3·43	vs	3·40	vs
					3·30	s	3·24	w	3·24	m
4	..	..	..	..	2·91	w	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..
6	2·75	s	2·72	m	2·75	s	2·76	m	2·74	m
7	2·52	m	2·48	m	2·53	m	2·51	m	2·49	w
8	..	..	..	..	..	..	..	..	..	..
9 } 10 }	2·37	s	2·34	s	2·42	m }	2·40	m	2·37	m
					2·38	m }				
11	..	..	..	..	..	..	..	..	..	..
12	2·22	w	2·20	vw	2·23	vw	2·21	vw	2·20	vw
13	2·12	w	2·10	w	2·15	w	2·13	w	2·12	w
14	2·00	s	1·98	s	2·01	s	2·00	s	1·98	s
15	1·90	m	1·88	m	1·91	m	1·91	m	1·89	m

B. Aragonite Patterns (*Contd.*)

Ring number	Specimen 8		Specimen 9		Specimen 11		Specimen 12		Specimen 14	
	d (Å)	Int.	*d* (Å)	Int.	*d* (Å)	Int.	*d* (Å)	Int.	*d* (Å)	Int.
1	..	..	..	..	..	..	..	..	..	..
2	3·56	s }	3·40	vs	3·38	vs	{3·40	vs	3·41	vs
3	3·42	m }					{3·27	m	3·26	m
4	..	..	3·08*	vw	..	..	..	..	2·87	vw
5	..	..	..	..	..	..	..	..	..	..
6	2·74	s	2·72	s	2·73	s	2·72	s	2·72	s
7	2·51	m	2·51	m	2·51	m	2·50	m	2·48	m
8	..	..	..	..	..	..	..	..	..	..
9	2·40	m }	2·37	s	2·38	s	2·36	s	2·36	s
10	2·37	m }								
11	..	..	..	..	..	..	..	..	..	..
12	2·22	vw	2·21	vw	2·21	w	2·20	vw	2·19	vw
13	2·15	w	2·12	w	2·12	w	2·11	w	2·11	w
14	1·99	s	1·99	s	1·99	s	1·98	s	1·99	s
15	1·89	w	1·90	m	1·90	m	1·88	m	1·88	m

* Probably due to a small amount of calcite present.

3. DISCUSSION

In the book by K. M. Wilbur and C. M. Yonge referred to above,[1] it is mentioned that calcite is much more common than aragonite, particularly in sea-water specimens. However, Jean Bouillon's list[2] indicates that aragonite occurs more often in shells than calcite. It is interesting that the author's results listed in Table I has shown the occurrence of aragonite in a somewhat larger percentage of his specimens than was found by Bouillon.[2] This study, however, is not extensive enough to indicate whether this is caused by the smallness of the sample survey or whether this is a particular feature of the warm, tropical regions. A more extensive and detailed study of Indian shells from this point of view would therefore be worthwhile. It is proposed to undertake such a study.

4. ACKNOWLEDGEMENTS

The author's thanks are due to the members of the Centre of Advanced Study in Biophysics of the University of Madras, in particular Dr. G. K. Ambady, for guidance and assistance in the X-ray studies. He is grateful to Dr. S. Krishnaswamy of the University of Madurai and Dr. K. Sanjeev Raj of the Madras Christian College, for the supply and identification of the specimens. A part of this work was initially done in connection with the Project Report for the Science Talent Search Examination, 1968.

---

1. Wilbur, K. M. and Yonge, C. M., *Physiology of Molluscs*, Academic Press, New York, 1964, **1**, Ch. 8.
2. Bouillon, *J. Ann. Soc. Roy. Zool. Belgique*, **1958–59**, **89**, 229.

ROLE OF BORON IN NUCLEIC ACID METABOLISM OF GERMINATING WHEAT SEEDLINGS

H. M. DANI, H. S. SAINI, I. S. ALLAG AND K. SAREEN
Department of Biochemistry, Panjab University, Chandigarh

ABSTRACT

Wheat seeds soaked for four hours in distilled water (control), 0·125%, 0·25% and 0·50% solutions of boric acid and borax were transferred to polythene dishes for germination. Treatments with 0·125% boric acid and borax were found to be optimum for accelerating seed germination process and seedling growth. Boron seems to help in mobilising nitrogenous hydrolysates from germinating seeds to young shoots. Both boric acid and borax increased ribonuclease activity in young shoots and isolated germinating seeds at all levels of concentration as compared to control. Ribonuclease, therefore, seems to be associated with the biosynthesis of RNA in actively growing tissues. There is also an increase in ribonucleotide concentration both in shoots and seeds with an increase in the concentrations of these compounds.

INTRODUCTION

A CRITICAL survey of literature reveals that out of all the hypotheses put forward by different investigators to explain the role of boron in plant metabolism, the recent suggestions[1-3] about its role in nucleic acid metabolism deserve detailed studies. These suggestions seem to be quite plausible in view of the higher concentrations of nucleic acids and their intervention in vital activities of meristematic tissues coupled with the observations that boron is localised in meristematic regions of plants. Boron has also been ascribed to play an important role in protein metabolism.[4,5] Its deficiency often decreases the protein content of plant tissues. Our observations[6] have already indicated that boron participates in protein biosynthesis through its control on RNA content.

The present investigation was undertaken to understand the role of boron, both in the form of boric acid and borax, in nitrogen mobilisation and polyribonucleotide metabolism during seed germination and seedling growth. Our major aim was to interpret the effects of boron on the above phenomenon in the light of the alterations brought about, if any, in the levels of total nitrogen, RNA, ribonucleotides and ribonuclease activity.

MATERIALS AND METHODS

Wheat seeds (*Triticum vulgare*) of Mexican variety (*Lerma rojo*) were soaked for four hours in distilled water (control), 0·125%, 0·250% and 0·50% solutions of boric acid and borax. Seedlings were raised in polythene dishes on a double layer of Whatman No. 44 filter-paper. Twenty healthy seeds were kept for germination in each dish and four such dishes were put under each treatment. Distilled water was applied to the germinating seeds at regular intervals of six hours. The experiment was conducted in a dark room at 26° C. Percentage germination and heights of the shoots in centimeters were recorded after every 24 hours interval.

Total nitrogen in young roots and shoots was separately determined in each sample by Microkjeldahl method.[7]

Plant tissues (germinating seeds and shoot tips) under similar treatments were pooled together for the preparation of acetone powder according to the method cited in Colowick and Kaplan.[8] RNA was estimated by the method of Schneider.[9] The changes in ribonuclease activity in the acetone powder were measured by a method described by Pardee and Kunkee.[10] Ribonucleotides were estimated by Ceriotti method.[11]

RESULTS AND DISCUSSION

Effect on Seed Germination.—Our observations (Fig. 1) clearly showed that 0·125% boric acid treatment was optimum for bringing about hundred percent seed germination in 48 hours. Even though higher concentrations of boric acid and borax were found to delay the process, yet the control seeds required the maximum time (192 hours). At 0·125% and 0·25% concentrations boric acid was found to be more effective as compared to borax. Hastening of seed germination by boron has also been reported[12] in the case of pineapple, ash and yellow accacia.

Effect on Nitrogen Mobilisation.—Maximum promotive effect on shoot growth was shown by 0·125% boric acid treatment (Fig 2). An explicit biochemical reasoning for this accelerated shoot growth due to boron treatments could be gathered by studying the nitrogen status of the young shoots for which the only source of nitrogen is the germinating seed. Our investigations (Table I) showed that there was a statistically highly significant increase in the total nitrogen content of shoots treated with 0·125% and 0·25% boric acid. With an increase in the concentrations of boric acid and borax, the rate of shoot growth was retarded and in the case of 0·5% treatments there was a negligible shoot growth after seed germination. Borax treatments had a less pronounced effect on shoot growth and its nitrogen status as compared to boric acid. Control roots contained higher concentrations of total nitrogen as compared to those treated with boric acid and borax. Boron thus helps in hydrolysing the seed proteins and directing their mobilisation more towards shoots than to the roots.

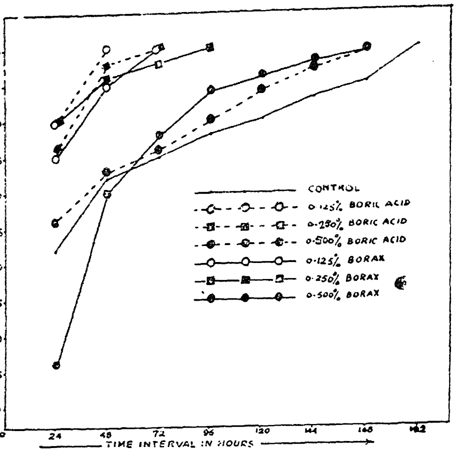


FIG. 1. Effect of various concentrations of boric acid and borax on percentage germination of wheat seeds.

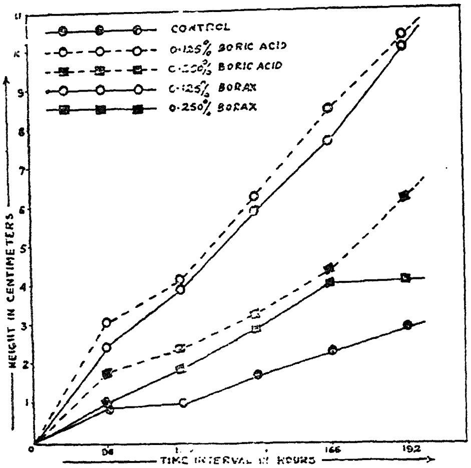


FIG. 2. Effect of various concentrations of boric acid and borax on the shoot growth of wheat seedlings. Each value represents a mean of 80 seedlings.

Effect on Nucleic Acid Metabolism.—Protein synthesis is known to be turned off in all parts of the resting seed. One reason for this might be the unavailability of the mRNA which is considered to be activated during imbibition.[13] Our observations (Table II) also showed a significant rise in the RNA content of wheat seeds after imbibition.

TABLE I

Statistical evaluation of percentage nitrogen in germinating wheat seedlings treated with varying concentrations of boric acid and borax

	Treatments				
	Control	Boric acid		Borax	
	– B	0·125%	0·250%	0·125%	0·25 %
Germinating shoots	0·828	1·064	0·989	0·914	0·839
S.D.	..	0·1258	0·0681	0·1826	0·1223
t value	..	3·253	4·090	0·759	0·556
Germinating roots	0·546	0·504	0·434	0·462	0·429
S.D.	..	0·0955	0·0643	0·0731	0·0711
t value	..	0·760	3·010	1·988	2·814

1. Each value represents a mean of six replications.
2. Significant at 5% level when t_{10} as compared to control $\geqslant 2·23$. Highly significant at 1% level when t_{10} as compared to control $\geqslant 3·17$.

Maximum ribonuclease activity was exhibited by 0·125% boric acid-treated wheat seeds. Both boric acid and borax were found to activate ribonuclease at all concentrations. Simultaneously, there was an increase in the RNA content of wheat seeds with increasing boron concentrations. At 0·125% concentration, both boric acid and borax were found to depolymerise RNA to the maximum, probably to be transported as nucleotides to meristematic tissues. Therefore, the seeds treated with 0·125% boric acid and borax were found to contain the minimum amount of RNA.

Studies in the shoot tips of the germinating seedlings (Table II) showed that both boric acid and borax enhanced the ribonuclease activity as compared to that in the control plants.

TABLE II

Changes in RNA, ribonuclease activity and ribonucleotides in germinating wheat seeds and shoot tips treated with varying concentrations of boric acid and borax

	Treatments										
	Seeds						Shoot tips				
	Control (−B)		Boric acid		Borax		Control (−B)	Boric acid		Borax	
	Dor.	Ger.	0·125%	0·25%	0·125%	0·25%		0·125%	0·25%	0·125%	0·25%
Ribonucleic acid (μg./mg. of acetone powder)	240·00	282·66	256·00	304·00	229·33	239·33	225·35	295·73	394·36	304·36	507·04
Unit RNase activity	0·00	5·00	20·00	15·00	17·00	12·00	25·00	30·00	38·00	30·00	34·00
Free Ribonucleotides (μg./mg. of acetone powder)	28·33	24·14	21·66	22·14	20·75	22·14	10·00	15·23	16·42	13·81	17·61

Dor.: Dormant, Ger.: Germinating.

The activity of this enzyme was found to increase with increasing concentrations of boron compounds. A simultaneous increase in the RNA content and ribonuclease activity with all the concentrations of these compounds was very intriguing. On the basis of these observations, the present authors support the suggestion put forward by Barker and Douglas[14] that the ribonuclease of the growing tissues is involved in the synthesis of RNA.

The values of ribonucleotides were found to increase with increasing concentrations of boric acid and borax in the case of young shoot tips. An increase in ribonuclease activity due to boron treatments could not be responsible for an increase in ribonucleotide concentration because of a simultaneous rise in RNA levels in shoot tips. Boron, therefore, seems to play some role in ribonucleotide biosynthesis.

A decline in ribonucleotide concentration in boron-treated seeds as compared to the control seeds showed that more ribonucleotides were probably transported from seeds to actively growing tissues for RNA synthesis.

CONCLUSION

Wheat seeds soaked in 0·125% boric acid for four hours take one-fourth time to reach 100% germination as compared to the control seeds. This treatment is also optimum for significantly mobilising nitrogenous hydrolysates from germinating seeds to young shoots as well as for promoting maximum shoot growth.

Boron treatments also increase ribonuclease activity which seems to help in the biosynthesis of RNA in young shoots. An accumulation of ribonucleotides in boron-treated shoot tips shows that the element might be involved in ribonucleotide biosynthesis.

ACKNOWLEDGEMENTS

The authors are highly indebted to the University Grants Commission for providing the financial assistance for carrying out this work. They are also thankful to Dr. M. K. P. Amma for critical suggestions and going through the manuscript.

---

1. Shkol'nik, M Ya. and Maevskaya, A. N., *Fiziol Rast.*, 1962, 9 (3), 270
2. Timashov, N. D., *Dokl. Akad. Nauk. SSSR* (Russ.), 1966, **169** (6), 1459.
3. Sherstnev, E. A., *Ibid.*, (Russ.), 1967, **175** (5), 1190
4. Vladimirov, E. N., *Uzb. Biol. Zh.* (Russ.), 1966, **10** (6), 18.
5. Enileev, Kh Kh and Andryushchenko, V. K., *Ibid.*, (Russ.), 1963, 7 (4), 23.
6 Saini, H. S., Dani, I. M., Allag, I S. and Sareen, K., *Curr. Sci.*, 1969, **38** (15), 355.
7. A.O A C., 1965.
8. Colowick and Kaplan, *Methods in Enzymology*, 1955, **2**, 63.
9. Glick, D., *Methods of Biochemical Analysis*, 1966, **14**, 155.
10. Pardee, A. B. and Kunkee,, *J. Biol. Chem.*, 1952, **199** 9.
11. Ceriotti, G., *Ibid.*, 1955, **214**, 59.
12. Stepanov, V. I., *Nauchn. Issedk.t. Apolesomelio* (Russ.), 1963, **45**, 23.
13. Marcus, A. and Feeley, J., *Proc. Natl. Akad. Sci., U.S.*, 1964, **51**, 1075
14. Barker, G. R. and Douglas, T., *Nature*, 1960, **188**, 943.

LETTERS TO THE EDITOR

MOLECULAR CONSTANTS OF TUNGSTEN HEXACHLORIDE MOLECULE

THE vibrational spectrum of tungsten hexachloride molecule was reported recently by Evans *et al.*[1] and the assignment of the fundamentals was made on the basis of octahedral symmetry of O_h point group. In the present paper, we are reporting the force constants calculated by the use of Urey Bradley and valence force potential functions. The symmetry co-ordinates and the corresponding potential and kinetic energy matrix elements are the same as given by Kim *et al.*[2] and Nakamoto.[3] The results are given in Table I along with observed and calculated frequencies.

The mean square amplitudes are calculated by the procedure outlined by Cyvin.[4] The elements of the Σ matrix are obtained by solving the secular equation $|\Sigma G^{-1} - E \Delta K| = 0$. Following the method of Morino and Hirota,[5] the mean square parallel $< \Delta Z^2 >$ and perpendicular $< \Delta X^2 >$, $< \Delta Y^2 >$ amplitudes of vibration are also calculated and are presented in Table II.

Using the molecular parameters and observed vibrational frequencies, the thermodynamic properties are calculated for an ideal gas state at one atmosphere pressure for twelve different temperatures and are listed in Table III.

TABLE I

Potential energy constants of tungsten hexachloride molecule[1]

F-matrix elements	Potential energy constants		Vibrational frequencies in cm $^{-1}$		
	G.V.F.F. (m.dyne/Å)	U.B.F F. (m.dyne/Å)		Observed	Calculated
$F_{11} = 3{\cdot}447$	$f_d = 2{\cdot}297$	$K = 2{\cdot}241$	a_{1g}	408	408
$F_{22} = 2{\cdot}033$	$f_{dd} = 0{\cdot}241$	$H = 0{\cdot}147$	e_g	312	312
$F_{33} = 2{\cdot}080$	$f_{dd}' = 0{\cdot}217$	$F = 0{\cdot}212$	f_{1u}	367	367·6
$F_{34} = 0{\cdot}200$	$f_\alpha = 0{\cdot}140$	$F' = -0{\cdot}123$		165	164·6
$F_{44} = 0{\cdot}930$	$f_{\alpha\alpha} = 0{\cdot}091$		f_{2g}	206	206
$F_{55} = 1{\cdot}132$	$f_{\alpha\alpha}' = -0{\cdot}041$		f_{2u}	97	97
$F_{66} = 0{\cdot}502$	$f_{d\alpha} = 0{\cdot}044$				

[1] W—Cl distance $= 2{\cdot}26$ Å and $\alpha = 90°$.

TABLE II

Mean square amplitudes of vibration for tungsten hexachloride at 298·16° K.

Σ matrix elements	σ elements Å²	Atom pair	Mean square parallel and perpendicular amplitudes Å²		
			$\langle\Delta Z^2\rangle$	$\langle\Delta X^2\rangle$	$\langle\Delta Y^2\rangle$
$\Sigma_{11} = 0{\cdot}001547$	$\sigma_d = 0{\cdot}005802$	W—Cl (bonded)	0·005803	0·001463	0·001463
$\Sigma_{22} = 0{\cdot}002399$	$\sigma_{dd} = -0{\cdot}000142$				
$\Sigma_{33} = 0{\cdot}009490$	$\sigma_{dd}' = -0{\cdot}003687$	Cl....Cl (non-bonded)	0·007610	0·007405	0·004734
$\Sigma_{34} = 0{\cdot}000485$	$\sigma_\alpha = 0{\cdot}004874$				
$\Sigma_{44} = 0{\cdot}001258$	$\sigma_{d\alpha} = -0{\cdot}000243$				
$\Sigma_{55} = 0{\cdot}003911$	$\sigma_{\alpha\alpha} = -0{\cdot}001808$	Cl—W—Cl	0·004230	0·001955	0·001955
$\Sigma_{66} = 0{\cdot}008490$	$\sigma_{\alpha\alpha}' = 0{\cdot}000482$				

Σ, σ, $\langle\Delta Z^2\rangle$, $\langle\Delta X^2\rangle$ and $\langle\Delta Y^2\rangle$ have the same meaning as in reference 4.

TABLE III

Thermodynamic properties for tungsten hexachloride molecule

T °K	$(H^\circ - E_0^\circ)/T$	$-(F^\circ - E_0^\circ)/T$	S°	C_p°
100	21·81	13·50	52·69	66·18
200	31·05	20·33	64·25	84·58
273·16	33·77	23·65	71·18	94·83
298·16	34·32	24·50	73·22	97·72
300	34·36	24·58	73·50	98·07
400	35·76	27·24	80·98	108·23
500	36·45	29·03	86·36	116·36
600	36·83	30·27	92·62	122·89
700	37·07	31·21	97·19	128·40
800	37·23	31·98	101·65	133·63
900	37·33	32·54	105·21	137·76
1000	37·41	33·01	108·64	141·65

H^0 heat content, F° free energy, S° entropy, C_p° heat capacity and E_0° is the energy per gram-mol of the perfect gas at $T=0$. Principal movements of inertia $I_{xx} = I_{yy} = I_{zz} = 362{\cdot}20$ at wt. Å².

We acknowledge with thanks the award of a Junior Research Fellowship by the Council of Scientific and Industrial Research to one of the authors (A. J. K.).

Division of Molecular Spectroscopy,
Dept. of Physics,
Poona University, Poona-7,
September 30, 1969.

A. J. KALE.
K. SATHIANANDAN.

---

1. Evans, J. C. and Lo, G. Y. S., *J. Mol. Spectroscopy*, 1968, **26**, 147.
2. Kim, H., Sauder, P. A. and Claassen, H. H., *Ibid.*, 1968, **26**, 46.
3. Nakamoto, K., *Infrared Spectra of Inorganic and Co-ordination Compounds*, John Wiley & Sons, Inc., New York, London, 1963, p 267.
4. Cyvin, S. J., *Acta Chem. Scand.*, 1959, **13**, 2135; *Acta Polyt. Scand.*, 1960, **6**, 279.
5. Morino, Y. and Hirota, E., *J. Chem. Phys.*, 1955, **23**, 737.

ESTIMATION OF DOWN-COMING LONG-WAVE RADIATION OVER INDIA

THERE is continuous need for assessing down-coming long-wave radiation R in many problems like energy balance studies at the surface. So precise methods for determining long-wave radiation at the earth's surface from clear skies have been developed with the use of radiation charts constructed by Elsasser (1940 and 1942) and of net radiometers by Gier and Dunkle (1951), Schulze (1953), and Funk (1959). It is sometimes necessary to make retrospective estimates of radiation from climatological data and it is likely, for some time to come, that radiation surveys over the ocean and land surfaces will have to rely largely on estimations based on the usual surface meteorological observations.

In the present note, the authors have evaluated the down-coming long-wave radiation from the atmosphere at the earth's surface over India (ten stations) from January 1964 to December 1964, with the aid of radio-sonde data for clear days, using the second revised Elsasser radiation chart. These observations, some 85 in all, are utilised and presented graphically in Fig. 1. The regression of R on σT^4 in Fig. 1 is:

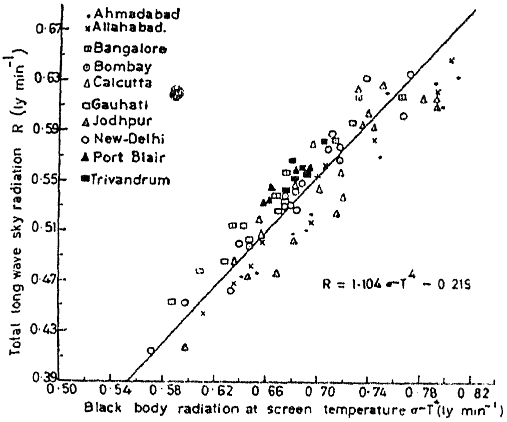


FIG. 1. Relation between incoming long-wave radiation and black body radiation.

$$R = 1{\cdot}104\ \sigma T^4 - 0{\cdot}219 \text{ langleys per minute} \quad (1)$$

The correlation is 0·99. The scattering of points from the regression line in Fig. 1, which in any case is not highly significant statistically, might be interpreted as meaning that the conditions at all the stations are not similar. It will be noticed, however, that the observations refer to all the stations with fairly distinct temperature regimes. The deviation in the regression line may therefore be real, the overall line of best fit being not straight but slightly curved and concave upwards. However, the strong dependence of R on T makes it comparatively independent of vapour pressure, as found in the observations, is thus confirmed. The dependence of R on T, which the analysis has shown to be virtually complete, must, of course, find its explanation in the properties of the absorption spectra of water vapour and carbon dioxide.

Formula (1) may be written as

$$R = 1{\cdot}104\ \sigma T^4 - 15{\cdot}278 \text{ milliwatts cm.}^{-2} \quad (2)$$

It is similar to that of Swinbank (1963) formula with different regression constants. Swinbank pointed out that this relationship will hold good upto considerable heights. The authors have verified the formula (1) at 850 mb. level for all the stations. The results are presented in Table I. It shows that the relationship (1) permits the estimation of incoming long-wave radiation at 850 mb. level with reasonable accuracy. The evidence presented in this note leads to the conclusion that formula (1) presents a good estimate of R for energy balance studies. Formula (1) may be less reliable when there is a strong lapse or inversion.

TABLE I

Verification of incoming long-wave radiation at 850 mb. level

Stations	Upward black body radiation	R calculated from eqn. (1)	R estimated from Elsasser chart	Error in per cent.
Ahmedabad ..	0·569	0·409	0·418	−2
Allahabad ..	0·530	0·366	0·375	−2
Bangalore ..	0·565	0·405	0·417	−3
Bombay ..	0·639	0·486	0·475	+2
Calcutta ..	0·561	0·400	0·396	+1
Gauhati ..	0·528	0·364	0·369	−1
Jodhpur ..	0·674	0·525	0·522	+1
New Delhi ..	0·684	0·536	0·523	+2
Port Blair ..	0·593	0·436	0·4[illegible]4	+3
Trivandrum ..	0·600	0·443	0·439	+1

Note: All values expressed in langleys per minute. T = Absolute temperature °C. σ = Stefan's constant.

The authors are thankful to their supervisor, Prof. R. Ramanadham, for helpful discussion and encouragement on this note.

Dept. of Meteorology and Oceanography,
Andhra University,
Waltair, *October* 9, 1969.

Y. VISWANADHAM.
Y. S. RAMAKRISHNA.
G. RAMAKRISHNA RAO.

---

1. Elsasser, W. M., *Q. J. Roy. Met. Soc.*, 1940, **66** (Supplement) 41.
2. —, *Harvard Met. Studies No* 6, 1942.
3. Funk, J. P., *J. Sci. Instr.*, 1959, **36**, 267.
4. Gier, J. T. and Dunkle, R. V., *Proc. Amer. Inst. E.E.*, 1951, **70**, 339.
5. Schulze, R., *Geofisica Pura e Applicata*, 1953, **261**, 107.
6. Swinbank, W. C., *Q. J. Roy. Met. Soc.*, 1963, **89**, 339.

MIXED LIGAND COMPLEXES OF *BIS*-ACETYLACETONATO MANGANESE (II) WITH NITROGEN DONOR LIGANDS

DIVALENT manganese ion has a symmetrical half-filled $3d^5$ non-bonding shell and forms usually hexa-co-ordinated complexes. Several adducts of acetylacetonates of Co(II), Zn(II), Cd(II) and Ni(II) with nitrogen donor ligands were reported earlier.[1–4] This communication describes some hexa-co-ordinated complexes of the type $Mn(acac)_2L_2$ where L is pyridine, γ-picoline, 3 : 5-lutidine, quinoline or isoquinoline.

The previously known *bis*-acetylacetonato manganese (II) has been prepared as a yellow compound by reacting an ethanolic solution of manganese chloride with acetylacetone in stoichiometric ratio followed by the addition of required amount of ammonia. Analysis of the compound corresponded to the composition $Mn(acac)_2.2H_2O$. I.R. spectrum of this compound shows a broad absorption band at 3525 cm.$^{-1}$ indicating the presence of co-ordinated water. Diaquo *bis*-acetylacetonato manganese (II) was *immediately* dissolved in different nitrogen donor ligands separately by warming. On cooling the resulting solutions, yellow crystalline compounds separated out. They were filtered, washed with ethanol and ether and dried *in vacuo*. The purity of the isolated compounds was established by estimating the metal by standard method. The conductance measurements were carried out using a Toshniwal conductivity bridge and magnetic susceptibilities were determined on solid specimens using Gouy method. I.R. Spectra were recorded using a Unicam SP-200 spectrophotometer with specimens mounted in Nujol. Analytical, conductance, magnetic susceptibility and I.R. spectral data are shown in Table I.

The yellow diaquo *bis*-acetylacetonato manganese (II) turns brown fairly rapidly presumably due to oxidation on exposure to air. However, these mixed ligand complexes are more stable than $Mn(acac)_2.(H_2O)_2$. Earlier, Graddon and Mockler reported[5] a pyridine adduct under different preparative conditions. Some hexa-co-ordinated complexes of the type $Mn(acac)_2L$ where L is a bidentate ligand were also reported by Syamal[6] and Dwyer & Sargeson.[7]

All the complexes reported now are fairly soluble in acetone in which medium they are non-electrolytes. These compounds are paramagnetic indicating the presence of five unpaired electrons. Thus they are spin-free, octahedral complexes of manganese(II) involving the use of $4s4p^34d^2$ hybrid orbitals for bonding.

The I.R. spectral data show definite shifts in the C–O and C–C absorption bands by the introduction of the heteroligands. This aspect was discussed in detail in an earlier paper.[4] These shifts and the modification of the ligand

TABLE I

Analyses, melting points, conductance, magnetic susceptibility and I.R. spectral data for mixed ligand complexes of manganese (II)

Compound		Colour and form	M P. °C. (*d*)	% Manganese		μ_{eff} (B.M.)	Λ_M (mhos)	ν (C—C)	ν (C—O)
				Found	Reqd.				
(acac)	..	..	..	..	..	..	..	1628 s	1553 s
Mn (acac)$_2$ 2H$_2$O	..	..	..	..	..	..	..	1615 s	1528 s
Mn (acac)$_2$L$_2$ where L is									
pyridine		Yellow crystalline	185	13·11	13·33	6·08	0·5	1602 s	1523 s
γ-picoline	..	do.	112	11·92	12·51	5·78	0·6	1607 vs	1518 vs
3 : 5-lutidine	..	do.	130	11·23	11·77	5·93	8·6	1598 s	1520 m
Quinoline	..	Deep yellow crystalline	120	10·53	10·75	5·93	1·6	1580 s	1523 m
Iso quinoline	..	do	110	10·31	10·75	5·72	0·4	1595 s	1518 s

s—sharp, vs—very sharp, m.—medium.

absorption bands (not shown here) indicate the bonding of the heteroligand to the metal. This fact coupled with the analytical data and the absence of the absorption band due to co-ordinated water in the I.R. spectra definitely shows hexa-co-ordination in these complexes.

Thanks are due to the Ministry of Education, Government of India, for the award of a Research Training Scholarship and to the Government of Orissa for the grant of study leave to one of us (A. K. D.).

Dept. of Chemistry,
Regional Engineering
College,
Rourkela-8, *September* 17, 1969.

ASOKE K. DAS.
D. V. RAMANA RAO.

---

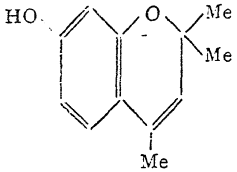
1. Paul, B. and Ramana Rao, D. V., *J. Inst. Chem.* (*India*) (accepted), 1969.
2. Mohapatra, B. K. and Ramana Rao, D. V., *Z. Anorg Allg. Chem.* (accepted), 1969.
3. Paul B. and Ramana Rao, D. V., *J. Indian Chem. So.* (in Press), 1969.
4. Misra M. K and Ramana Rao, D. V., *J. Inorg. Nucl. Chem.* (in Press) 1969.
5. Graddon, D P. and Mockler, G. M., *Aust. J. Chem.*, 1964, **17**, 1119.
6. Syamal, A., *J. Inst. Chem. (India)*, 1968, **40** (4), 131.
7. Dwyer, F. P and Sargeson, A. M., *J. Proc. Roy. Soc.*, 1956, **90**, 29.

SYNTHESIS OF 4, 6-DIMETHYLXANTHYLETIN

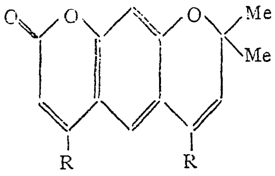
XANTHYLETIN (II *a*), a naturally occurring benzo dipyran-2-one occurring in the varied species of the plant kingdom[1] which includes *Luvanga scandens* (Kakla), a plant widely used in Hindu medicine,[1b] was synthetically obtained in very poor yield[2] in the condensation of 7-hydroxycoumarin with 3-methyl-but-1-yne-3-ol together with its angular isomer Seselin which is the major product in the reaction. Recently, its synthesis from 6, 7-dihydroxanthyletin[3,4] is also reported.[4,5] In the course of our work on chromenes an elegant synthesis for 4, 6-dimethylxanthyletin (II *b*) is developed from easily accessible 7-hydroxy-4-methylcoumarin.

7-Hydroxy-2, 2-dimethyl-2H-chromene[6] (I) was prepared in excellent yield by the reductive cleavage of the benzyloxy group of 7-benzoyloxy 2, 2-dimethyl-2H-chromene[6] (this is obtained in good yield from benzyl ether of 7-hydroxy-4-methylcoumarin by the action of methyl magnesium iodide) by catalytic hydrogenation over Raney Nickel at atm. pressure, which is found to be far better method than the one reported for debenzylation.[6] Condensation of (I) with ethyl acetoacetate in presence of anhydrous AlCl$_3$ in PhNO$_2$ furnished a good yield of 4, 6-dimethylxanthyletin (II *b*) [4. 6, 8, 8-tetramethyl-2 H, 8 H-benzo (1, 2 *b*; 5, 4-*b*′) dipyran-2-one] crystallised from ethanol as needles m.p. 172–73°; Found C, 75·0, H, 6·6; C$_{16}$H$_{16}$O$_3$ requires C, 75·0 and H, 6·2%; U.V. absorption $\lambda_{\text{Max.}}^{\text{MeOH}}$ 225, 263, 300 (shoulder), 348; (log. ϵ 4·84, 4·75, 4·12, 4·58). The condensation could also be effected with H$_2$SO$_4$ (80%) and also with BF$_3$ in ether, but the yields were comparatively low. The possibility of a 2-methyl-γ-pyrone ring formation was eliminated as II *b* failed to give any styryl derivative on treating with benzaldehyde and NaOEt in EtOH, a characteristic reaction of 2-methyl-γ-pyrones.[7]

The linear constitution for II *b* that is assigned is based on NMR spectrum which showed signals at δ 1·4 (6H, S, gem-dimethyl at C–8), 2·1 (3H, S,* - Me at C-6), 2·4 (3H, S,* - Me at C–4), 5·5 (1H, S*, at C-7), 6·1 (1H, S* at C–3), 6·7 (1H, S, at C–10) and 7·3 (1H, S, at C–5). The singlets for the aromatic protons with δ at 6·7 and 7·3 rules out the other alternative possibility of the angular structure due to condensation in position 8 of (I). Had it been angular structure then there would have been doublets for the aromatic protons (at C-5 and C-6) due to vicinal coupling. U.V. absorption values also closely agree with those reported for xanthyletin[1c] (II *a*) ($\lambda_{\text{Max.}}^{\text{MeOH}}$ 266, 348; log ϵ 4·34, 4·15).

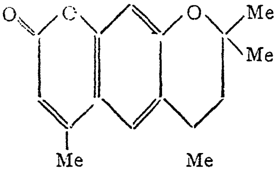


I



II

[*a*. R=H; *b*, R=Me]



III

Catalytic hydrogenation of II *b* over Raney Nickel at 45 lb. pressure gave 4, 6-dimethyl-6, 7-dihydroxanthyletin (III) in nearly quantitative yield (crystallised from ethanol as colourless needles, m.p. 155-56°; Found C, 74·4, H, 6·9; $C_{16}H_{18}O_3$ requires C, 74·4, H, 6·9%. U.V. absorption $\lambda_{\text{Max.}}^{\text{MeOH}}$ 230, 328 (log ϵ 4·73, 4·92). Condensation of 7-hydroxy-2, 2-dimethylchroman[6] with ethyl acetoacetate in presence of H_2SO_4 (80%) also gave (III) in very good yield as adjudged by m.p. and mixed m.p. of the two samples.

The authors offer their thanks to Dr. T. R. Govindachari, Director, CIBA Research Centre, for NMR spectrum.

Organic Chemistry
Research Laboratories,
Institute of Science,
Bombay-32, *September* 25, 1969.

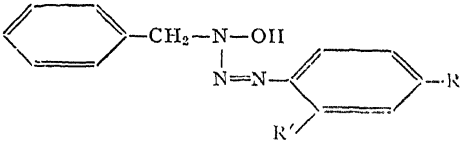
F. M. Faquih.
R. N. Usgaonkar.

---

1. (*a*) Bell J. C. and Robertson, A., *J. Chem. Soc.*, 1936, 677, 1828; (*b*) Bose, P. K. and Mookherjee, *J. Ind Chem. Soc.*, 1944, **21**, 181. (*c*) King, F. E., Housley, J R. and King, T. J., *J. Chem. Soc.*, **1954, p. 1392.**
2. Spath, **E.** and Hillel. R., *Ber.*, 1939, **963** 2093.
3. Bell, J. C. Bridge W. and Robertson, A., *J. Chem. Soc.*, 1937 p. 1542.
4. Dasgupta, A. K and Das K. R, *Ibid.*, 1969 **C,** 33
5. Ganguly. A K., Joshi. B. S., Kamat, V. N. and Manmade, A. H., *Tetrahedron*, 1967, **23**, 4777
6. Bridge, W., Crocker, **A.** J., Cubin J. and Robertson A., *J. Chem. Soc*, 1937, p. 1534.
7. Heilborn I M., Barnes, H. and Morton, R. A., *Ibid.* 1923, p 2559; King, F. E. and Robertson, A, *Ibid.*, 1934 p 403; Chakrabarti D, *J Ind. Chem. Soc*, 1931, **8**, 129; *Ibid.* 1936, **13**, 619.

STUDIES IN HYDROXYTRIAZENES

The successful use of 3-hydroxy-1, 3-diphenyl triazene and its substituted derivatives in the gravimetric and colorimetric determination[1] of Cu, Pd, Ni, Ti, etc., suggests that the synthesis and examination of some analogous compounds may be profitable. Another observation[2] that 3-hydroxy-1-phenyl-3-benzyltriazene imparts an indigo colour to ferric chloride solution and gives a brownish buff precipitate with Cu(II) led the present authors to synthesise other analogous compounds and study their properties and reactions towards metal ions. In this communication, ten hydroxytriazenes (represented by the general formula I)



I

prepared by condensing benzyl hydroxylamine with various diazonium compounds prepared from aniline or substituted anilines have been reported, most of them for the first time.

The ligands were prepared by adding diazotised aniline or its substituted derivative in thin stream to a freshly prepared solution of benzylhydroxylamine in 70% alcohol at 0° C. under constant stirring. The pH of the reaction medium was adjusted to be near 5 by adding small portions of sodium acetate solution (10% wt./vol.) at regular intervals. The temperature was maintained at 0° C. by adding ice. All of the hydroxytriazenes got precipitated and were filtered, washed repeatedly with distilled water and dried in vacuum except in the case of the sulphonic acid derivative which was water-soluble and hence salted out of the medium with sodium chloride. The *ortho*-tolyl derivative was a liquid and hence recovered by extraction with ether.

TABLE I

Physical characteristics of hydroxytriazenes

Compound		Colour	m.p. °C.	Microanalysis data					
				Found (%)			Calculated value (%)		
R	R′			C	H	N	C	H	N
H	H	White	105°C.	69·21	5·9	17·91	68·71	5·76	18·4
Cl	H	,,	142–144°C.	60·38	4·81	15·92	59·67	4·61	16·05
H	Cl	,,	75°	59·10	5·2	15·82	59·67	4·61	16·05
CH_3	H	,,	100	70·49	6·5	17·27	69·69	6·26	17·42
H	CH_3	Brown	129 (B.P.)	70·36	6·36	17·31	69·61	6·26	17·42
NO_2	H	Yellow	174	57·92	5·0	21·01	57·35	4·44	20·58
Br	H	White	153	51·67	4·3	13·52	51·00	3·95	13·73
COOH	H	Yellow	199	63·6	5·03	15·21	61·98	4·83	15·49
H	COOH	,,	138	62·31	5·21	15·81	61·98	4·83	15·49
SO_3Na	H	Pale violet	Stable upto 255°C.	45·37	4·31	11·90	44·94	4·062	12·10

The physical characteristics of these hydroxytriazenes are given in Table I. They are stable under atmospheric conditions and are highly soluble in alcohol, benzene, acetone, dioxane, etc., except in the case of the sulphonate derivative which is water soluble. Their aqueous and alcoholic solutions are stable and can be preserved for several weeks.

Reactions of these ligands towards metal ions have been observed. The formation of stable coloured precipitates or complexes in solution has been indicated in several cases under certain pH conditions. The colour reaction of 3-hydroxy-1-p-parachlorophenyl-3-benzyl triazene have been summarized in Table II.

TABLE II

Reactions of 3-hydroxy-1-parachloro-phenyl-3-benzyltriazene

Metal ion added	Colour of reaction	pH	Remarks
Pd	Violet ppt	1·6–7	Stable, granular and insoluble in water
Cu^2	Chocolate-brown ppt	1·7–7	do.
Co^2	Brown ppt.	4·7–7	do.
Ni^2	Yellow ppt.	4·7–7	do.
Fe (III) Fe (II)	Green soluble complex; becomes blue at higher pH	~2	Unstable to heat
Ti (IV)	Yellow colour	~2	Unstable
V (IV)	Dirty green ppt.	~2	Unstable to heat
V (V)	Green ppt.	~2	do.
Mo(VI)	Orange-yellow ppt	~2	do.
Ce (IV)	Slightly pale yellow	~2	do.

All other hydroxytriazenes synthesised gave similar reactions with metal ions. Ag(I) and Au(III) solutions get reduced by the reagents to the metallic state. Alkaline metals, alkaline earth metals, Zr, Th, Pt, Rh, Ru, Ir, Ge, Be, Mn, UO_2^{2+}, Cr, Al, As, Sb, Bi, Zn, Cd, Hg, Pb, Sn, do not show any reaction. Similarly, anions like oxalate, tartrate, fluoride, phosphate and borate do not give any reaction with the reagent. The precipitation of some of the metal ions seem to be complete as evident from the application of known spot tests to the respective metal ions in the filtrate.

The use of some of these hydroxytriazenes as gravimetric reagents is very much indicated and is under study.

The authors wish to thank Prof. S. C. Bhattacharyya and Prof. Hira Lal for their interest in the work and Prof. A. B. Biswas for providing the facilities.

Dept. of Chemistry,
Indian Institute of
Technology,
Powai, Bombay-76,
September 16, 1969

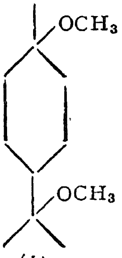
N. KUPPUSWAMY.
H. D. BHARGAWA.

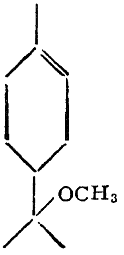
---

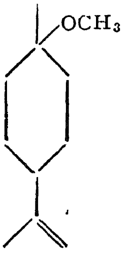
1. Purohit, D. N., *Talanta*, 1967, **14**, 353.
2. Bamberger, E. and Renauld, *Ber.*, 1897, **30**, 2280.

ON THE METHYL ETHERS OF LIMONENE

REACTION of (+) or (−)-limonene with alcohols in presence of acid catalysts leads to ethers.[1-3] Royals[4] demonstrated that (+)-limonene on heating with methanol containing conc. sulphuric acid (10% by weight) at 55-60° for 5 hr. afforded (*i*) 7% 1,8-dimethoxy-*p*-menthane (I) and (*ii*) 40% terpinyl methyl ether. These ethers were identified exclusively through molecular refractions which compared excellently with calculated values. As regards the monoether, it was presumed to be an isomeric mixture, the major component being 8-methoxy-*p*-menth-1-ene (II). A supplementary experiment showed that the methyl ether of supposed structure (II) available from α-pinene and *d*-limonene were apparently identical.[4,6]


(I)


(II)


(III)

In agreement with the observations of Royals, the reaction of *d*-limonene with methanol in presence of conc. sulphuric acid gave respectively the mono and diether fractions (1) b.p. 106–107·5°/20 mm., and (2) b.p. 124–127°/20 mm. Glc run revealed that the monoether cut was made up of essentially two components in the ratio 88 : 10 (peak area); the diether was homogeneous.

An insight into the nature of the monoether fraction was provided by the i.r. and n.m.r. spectra. The principal bands in the i.r. spectrum (neat) are the following: 850 (m), 890 (s), 1445 (s) and 1645 (w) cm.$^{-1}$ $(> C = CH_2)$; 805 (s), 820 (m) cm.$^{-1}$ $(> C = CH-)$; 1365 (s), 1382 (s) (doublet, gem-dimethyl); 1089 (broad), 1120 (w), 1140 (s) cm.$^{-1}$ $(-OCH_3)$.[7,8] The absorptions disclosing the di- and tri-substituted double bond linkings lend additional support to the fact that the monoether in question is essentially a two-component isomeric mixture and that the ethers may be represented by structures (II) and (III). This is confirmed by the n.m.r. data. In the n.m.r. spectrum ($CDCl_3$) the dominant peak is at τ 4·53 (triplet, not well resolved, C_2-H); other signals are at τ 6·80 (singlet, $-OCH_3$), τ 7·97 (doublet, hydrogens at C_3, C_4, C_5 and C_6) and τ 8·90 (singlet, $-CH_3$); these assignments are in keeping with structure (II). On the other hand, if the peak at τ 4·53 were due to C_2–H, the ratio of this proton to the remaining protons should be 1 : 19 (total 20 protons). Integration, however, shows a ratio of $\sim$ 1 : 32. The isomer (III), which is revealed by the signal centered at τ 5·25 attributable to the end-of-chain methylene protons, may be responsible for this increased proton ratio.

From the foregoing it is clear that the monoethers available from *d*-limonene are represented by structures (II) and (III).

As regards the diether, the i.r. spectrum (neat) shows peaks at 1370 and 1388 cm.$^{-1}$ (doublet, gem-dimethyl) and at 1085 (broad) and 1140 cm.$^{-1}$ $(-OCH_3)$; there is no absorption due to unsaturated linkings. The n.m.r. spectrum ($CDCl_3$) of the diether includes three distinct areas: (*a*) an unsymmetrical doublet centered at τ 6·82 corresponding to 6 protons $(-OCH_3)$; (*b*) a complex signal at τ 8·35 spread out to a width of 49 cps., corresponding to hydrogens at C_2, C_3, C_4, C_5 and C_6 and (*c*) a singlet centered at τ 8·88 corresponding to $(-CH_3)$.

The above spectral features are consistent with formula (I) for the diether.

Etherification.—Pure *d*-limonene [glc, single peak, n_D^{20} 1·4720, $(\alpha)_D^{30} + 126·5°$ (*c* 1. $CHCl_3$)] (40 g.), was added to a solution of conc. sulphuric acid (8 g.) in anhydrous methanol (38·4 g.) in a three-necked flask fitted with a reflux condenser and a thermometer dipping in the reaction mixture. The flask was placed on a pyromagnetic stirrer and the contents agitated for 5 hr. at a temperature of 55–60°. It was cooled to room temperature, diluted with water (100 ml.), washed with saturated solution of sodium bicarbonate (50 ml.), again with water (75 ml.) and dried over anhydrous sodium sulphate (yield 40 g). Rectification of the oil in Todd Assembly using 90 cm./25 mm. column packed with single-turn glass helices at 20 mm. pressure and a reflux ratio of 25 : 1 gave the following fractions: (*a*) 12 g., b.p. 73–106°; (*b*) 12·2 g., b.p. 106–107·5°, n_D^{25} 1·46445, d_{30}^{30} 0·8919, $(\alpha)_D^{30} + 30·30°$ (*c* 2, $CHCl_3$); (*c*) 1·8 g., b.p. 107·5–124°; and (*d*) 6·6 g., b.p. 124–127°, n_D^{25} 1·4535, d_{30}^{30} 0·9279, $(\alpha)_D^{30} \pm 0°$ (*c* 2, $CHCl_3$).

Analyses of fractions (b) *and* (d):—1. Glc run: The chromatographic apparatus used was F & M Model 700–1199 F. The recording parameters were: Column dimensions: length 6′, *i.d.* ¼″; Stationary phase: 10% silicone rubber SE30 on 80–100 S; Carrier gas: Nitrogen; Inlet pressure: 60 psi; Column temperature: 132°; Chart speed: ½″/min. Amount of oil: 0·8 μl.

Result: Fraction (*b*) two major peaks.
Fraction (*d*) single peak.

2. I.r. and n.m.r. data as discussed above.

We are indebted to Minute Maid Company, Plymouth, Florida, for a generous gift of *d*-limonene and to Mr. K. C. Nainan and Dr. K. K. Sugathan for the n.m.r. and i.r. spectra.

Dept. of Chemistry, K. P. JOHNY.
Christian Medical College, J. VERGHESE.
Vellore, *September* 13, 1969.

---

1. *British Pat.*, 494, 504 (to Hercules Powder Co.); *CA*, 1939, **33**, 2535
2. Sheffield, D. H., (to Hercules Powder Co.), *U.S. Pat.*, 2, 251. 214, July 29, 1941; *CA*, 1941, **35**, 7062.
3. Suga, K. and Watanabe, S., *Chiba Daigaku Kaga-kuou Kenkyu Hokoku 11*, 1960, No 20, 29; *CA*, 1961 **55**, 21159.
4. — and —, *Nippon Kagaku Zasshi*, 1960 **81**, 1139; *CA*. 1962, **56**. 507
5. Royals, E. E., *J. Am. Chem. Soc.*, 1949, **71**, 2568.
6. Treibs, W., *Ber.*, 1937. **70**, 593.
7. Bellamy, L. J., *The Infra red Spectra of Complex Molecules*, John Wiley & Sons, Inc., New York, 1956, p. 116.
8. Stradling, S. S. and Tarbe, D. S., *J. Org. Chem.*, 1964, **29**, 1172.

PREPARATION OF SOME BENZHYDROLS-α-D

OUR interest in the kinetics of the oxidation of some substituted benzhydrols by one or two electron-abstracting reagents necessitated the preparation of deuterated analogues to study the primary kinetic isotope effect and the effect of substituents on the extent of C-H bond rupture in the rate-limiting step. Using a modification of the method of preparation of protiated benzhydrols,[1] we have been able to prepare benzhydrol-α-D (85 ± 3% deuterated) and 1-(*p*-chlorophenyl) 1-phenyl methane-1-ol-α-D (88 ± 3% deuterated) as analysed by NMR. The method is very simple and easily adaptable in ordinary laboratories.

The preparation has been done in all-glass apparatus having quickfit joints. In a 200 ml. erlenmeyer flask fitted with a calcium chloride guard tube are taken D_2O* (30 g.) and pure anhydrous ethylacetate (100 g.). The heterogeneous solution was stirred magnetically and freshly-cut sodium pieces (10 g.) were gradually added so that the temperature of the reaction mixture did not rise appreciably. After complete addition of sodium, the guard tube was replaced with a double-walled, water-cooled reflux condenser fitted with a guard tube and reaction mixture was heated till half-an-hour after the two layers of the reaction mixture had disappeared. Pure dry benzophenone (10 g.) and dry zinc dust (10 g.) were added to this stirred solution and heated at 80-90° C. for two hours. The solution, after cooling, was filtered at the pump and the residue was washed with 10 ml., portions of alcohol. The filtrate was poured over crushed ice and acidified with concentrated hydrochloric acid (10 ml.). The separated solid was filtered at the pump and purified by passing through a column of neutral alumina‡ using petroleum ether (40-60°) as the eluent. The yield of deuterated benzhydrol was 60-62%, m.p. 68° (D content by NMR was found to be 85 ± 3%).

1-(*p*-chlorophenyl) 1-phenyl methane-1-ol-α-D was prepared as above from p-chlorobenzophenone, yield 60-62%, m.p. 60-62°, (D content 88 ± 3%).

We are thankful to Prof. G. V. Bakore, for providing facilities, and to Prof. Kanekar, for the NMR analysis. One of us (R. S.) is thankful to the University Grants Commission, for a financial grant.

Dept. of Chemistry, RAMASHANKER.
M.B. College, University K. S. SURESH.
of Udaipur, Udaipur, India,
September 25, 1969.

---

*Supplied by Bhabha Atomic Research Centre, Trombay, Bombay, India (Purity > 99·[illegible]%).

‡Supplied by the National Chemical Laboratory, Poona, India.

1. Vogel, A. I., In *Elementary Practical Organic Chemistry* Longmans, Green & Co., New York, 1958, p 314.

MESOLITE FROM POONA

THE mineral mesolite has long been reported under the group of secondary minerals in the Deccan Lavas in the *Manual of Geology of India and Burma.** Its precise occurrence at and around Poona has been reported by Sowani (1953) and he has also given its optical properties. A detailed account of the chemical characters, optical properties and crystal structure along with X-ray data has been made available by Deer and others (1962). Mr. Belsare's article (1969) on mesolite is likely to give a false impression that Sowani and Phadke (1964) have described mesolite, etc., as natrolite. It may be noted that the article referred to by him is about the mineral apophyllite and the term natrolite, while giving the associations of apophyllite, has been used as a group name for the fibrous zeolites.

Belsare has stated that distinction between mesolite and scolecite on the basis of chemical studies affords an easy identification. But a replacement of the type Ca ⇌ Na_2 is possible and from the chemical analyses of mesolite by Deriu (1954) and the one by Antonin (1942), it will be seen that poverty in lime or soda cannot be taken as a criterion for the distinction between the two minerals. Further, Belsare has gone too far in his argument that natrolite is unlikely in the lime-rich paragenesis as Poona. One fails to understand if such paragenesis has ever been delineated.

Zeolites have been subdivided into three groups on the bases of their structure and morphology. The natrolite group includes the fibrous zeolites such as natrolite, mesolite, scolecite, thomsonite, gonnardite and edingtonite. These minerals have a similar structure where linkages of tetrahedra are more numerous in one crystallographic direction than in the plane at right angles and hence have a fibrous growth.

The primary distinction between the fibrous members may be made on the basis of their optical characters (Deer *et al.*) and their precise identification from the study of powder patterns of X-ray diffraction. Though the optical characters of mesolite are likely to show a change on dehydration its structure remains the same.

Fergusson College,
University of Poona,
Poona-4, *October* 3, 1969.

A. V. PHADKE.

---

1. Antonin, R., "Research on the minerals and ores of Vinaricka hill." *Vestnik Kral. Ceske Spol. Nauk*, 1942 (M A. 10-30).
2. Belsare, M. R., *Curr. Sci.*, 1969, **38** 292.
3. Deer, Howie, Zussman, *Rock Forming Minerals, Framework Silicates*, Longmans, Green and Co., Ltd., London, 1962, **4**.
4. Deriu, M., "Mesolite di Rio Cambone (Montiferro-Sardegna centro-occidentale." *Petrodico Min-Roma*, 1954, **23**. 37 (M.A. 12-486).
5. Pascoe Sir Edwin, H., *A Manual of Geology of India and Burma*, Vol. III, 3rd Edn., Chap. XXVII, p 1365.
6. Sowani, P. V., "A note on rocks around Poona," *M Sc. Thesis*, Univ. Poona, 1953. Part II. p. 145.
7. — and Phadke, A. V., "A note on Apophyllite occurring around Poona." *Jour. Univ. Poona Sci. and Tech.*, 1964, Sec. No. 28, p. 81.

OCCURRENCE OF THE APHIDOPHAGOUS SYRPHID FLY *SYRPHUS LATIFASCIATUS*, MACQ. (SYRPHIDAE : DIPTERA) IN SOUTH INDIA

THOUGH numerous species of adult Syrphids (Order: Diptera) have been described by Brunetti (1923) from the standpoint of taxonomy, literature on the biology of Indian Syrphids is scarce. Information on the life-habits of especially the aphidophagous Syrphids may prove useful in the biological control of aphids.

The author has found *Syrphus latifasciatus*, Macq., to be a commonly occurring aphidophagous Syrphid in the plains of South India. Brunetti (1923) described the adult of this species from a specimen collected at Simla. Bibliography of literature does not show report of this species from South India. From the author's field observations of this Syrphid fly for two years, it is noted that the fly is commonly seen from November to February, *i.e.*, during winter in South India. The larva of this Syrphid is a predator on aphids and therefore it provides an effective check on the increase of aphid population in nature.

The larva of *S. latifasciatus* feeds avidly on aphids infesting useful crops like brinjal, chillies, knolkol, garden beans, gliricidia, citrus and cholam. *Aphis craccivora*, *Toxoptera citricidus*, *Aphis gossypii*, and *Myzys persicae* are the common aphid species consumed by the Syrphid larva.

The full-grown larva of the Syrphid fly is about 10-12 mm. in length. It is leaf-green in colour with a white streak along the mid-dorsal line. The colouration harmonizes with that of the leaf surface, on which the larva leads a sluggish life. As described by Bhatia (1939) in his study of Syrphid larvae of Cambridge, England, the mode of food capture and feeding by the aphidophagous Syrphid larva is characteristic. Anchoring its broad hind end to the substratum, the larva raises and strikes out its anterior end in all directions (Fig. 1) The aphid that comes into contact with the anterior end of the predator is entangled in the sticky saliva. Then, by the action of the mouth parts, the entire soft parts of the victim are sucked out and the empty skin is discarded.

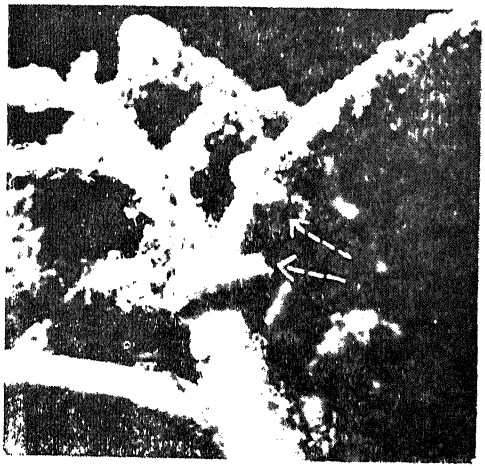


FIG. 1. Arrows indicate two larvæ of *Syrphus latifasciatus* amidst a colony of aphids.

The fæcal matter of the Syrphid larva dries up as black patches on the leaf surface. Often occurring along with other aphidophagous insects like the larvæ of Coccinellidæ and Chrysopidæ the Syrphid larvæ are responsible for a heavy destruction of aphids. Unidentified Hymenopterous parasites have been recovered from some of the larvæ of *S. latifasciatus*.

The puparium of the Syrphid is oblong in shape and is generally fastened to the undersurface of the leaf. The adults are found hovering about flowers. Hovering flight is a distinctive feature of the members of Syrphidæ. The flies reared out of puparia could be maintained alive for about a week in the insect cage on 20% sugar solution supplied in a wad of cotton.

Thanks are due to the authorities of Pachaiyappa's College for facilities and encouragement.

Dept. of Zoology, N. P. KALYANAM.
Pachaiyappa's College,
Madras-30, India, *December* 18, 1969.

---

1. Bhatia, M. L., *Parasitology*, 1939 **31**, 78.
2. Brunetti, E., *The Fauna of British India* (Diptera), 1923, **3**, 424.

WAK GOLDMANNI (BLEEKER) (PISCES : SCIAENIDAE): A NEW RECORD FROM INDIAN WATERS

DURING a study on sciænids of the Hooghly Estuary, nine specimens of *Wak goldmanni* (Bleeker), a species hitherto unreported from Indian waters, were collected in March, 1969. The species is known to occur only from the East Indies and the Philippines (Fowler,[1-3] Weber and de Beaufort,[4] Herre[5]).

The structure of the gas bladder and the nature of mandibular teeth discount the inclusion of "*Corvina*" *goldmanni* in any of the genera to which it was earlier assigned by previous workers (Bleeker,[6-8] Günther,[9] Fowler,[1-3] Weber and de Beaufort[4] and Herre[5]). "*Corvina*" *goldmanni* Bleeker has a hammer-shaped Otolithini gas bladder and this, the terminal mouth and differentiated teeth in both jaws place it in the genus *Wak* Lin, 1938. A description of the species based on the nine examples measuring 78–113 mm. in standard length, is given below:

Wak goldmanni (BLEEKER) COMB. NOV.

Corvina goldmanni Bleeker, 1854, **7**, 371; *Sciæna goldmanni* Günther, 1860, **2**, 293; *Pseudosciæna goldmanni* Bleeker, 1877, **9**, Fig. 5; *Argyrosomus goldmanni* Fowler, 1918, **70**, 43; *Johnius goldmanni* Fowler, 1933, **12**, 387; *Pseudosciæna goldmanni* Weber and de Beaufort, 1936, **7**, 507.

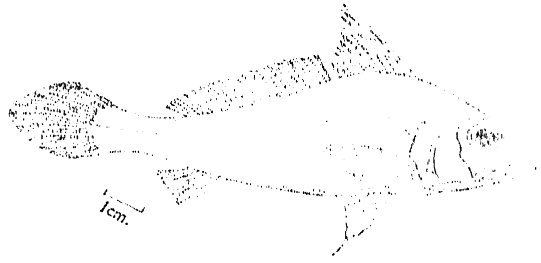


FIG. 1

D.X. 1 + 27–28; A. 11 + 7; P. 17–18; L.l. 47–52; L. tr. 4–5/9–12; G.R. 5–6 + 11–12.

Body depth 25·0–35·2; head length 30·6–38·7; eye diameter 9·5–11·4; lower jaw length 15·4–16·3; maxilla length 14·1–15·9; second anal spine length 9·5–12·8; all in percentage of Standard Length.

Body oblong, compressed. Mouth terminal, oblique; maxilla extends upto the posterior margin of eye. Snout blunt, its margin entire. Preopercle denticulate. Snout without any pore, lower jaw with five pores at symphysis. Villiform teeth in both jaws, outer row of upper jaw and inner row of lower jaw enlarged, not as canines. Cycloid scales on head, ctenoid on body. Dorsal spines weak, 4th longest. Anal originates opposite 11th–12th dorsal ray, second anal spine moderate, 2/3rd of the first ray. Gas bladder hammer-shaped Otolithini form with 13–14 pairs of arborescent appendages. Sonific muscles present in males only. Back dull brown, below whitish. Spinous dorsal black; soft dorsal, anal and caudal dusky.

Our specimens agree well with Bleeker's[8] figure and Fowler's[3] description except in having a lower gill raker count (5–6 + 11–12 *vs.* 8 + 12).

The authors are thankful to Dr. A. P. Kapur, Director, for encouragement and to Dr. A. G. K. Menon, Superintending Zoologist, Zoological Survey of India, for helpful suggestions in the preparation of this note.

Zoological Survey of India, P. K. TALWAR.
Calcutta-13, ASHA JOGLEKAR.
September 8, 1969.

---

1. Fowler, H. W., *Proc. Acad. Nat. Sci.*, Philadelphia, 1918, **70**, 43.
2. —, *Ibid.*, 1927, **79**, 286.
3. —, *Bull. U.S. Nat. Mus.*, 1933, **12** (100), 387.
4. Weber, M and de Beaufort, L. F., *Fishes Indo-Australian Archipelago*, 1936, **7**, 570.
5. Herre, A. W., *Research Report 20*, Fish and Wild life Service U.S. Deptt. of Interior, 1953, p. 475.
6. Bleeker, P., *Nat. Tijds. Nederland Indie*, 1854, **7**, 371.
7. — *Ibid.*, 1858, **17**, 145.
8. — *Atl. Ichch*, 1877, **9**, Tab. 376, fig. 5.
9. Günther, A., *Cat. Fish. Brit. Mus.*, 1860, **2**, 293.

EXCHANGE FIGURES IN MITOSIS

EXCHANGE figures, especially quadriradials in somatic cells, have been reported to occur occasionally. Patau[1] found two in 6,000 metaphases; James German[2] has discussed his findings on 21 quadriradials from a study of some hundreds of metaphases over a 4-year period. The rarity of their occurrence and the recent hypothesis of somatic crossing-over in mammalian cells, prompts this reporting of 2 cross-like exchange figures (quadriradials) in over 2,000 metaphases in a period of 2 years.

First exchange figure (Fig. 1) was from a normal female, aged 30 years, the sib of a woman under investigation for habitual abortion. The cell showing this exchange figure was the only abnormal one. Analysis of the other spreads showed a normal 46/XX karyotype. Out of the 30 spreads read microscopically, 5 showed aberrations like chromatid and chromosome breaks and acentric fragments. The karyotype of the one abnormal cell showed a deficiency for a pair in the C group, apart from the quadriradial which appeared to be made up of 2 homologous group C chromosomes.

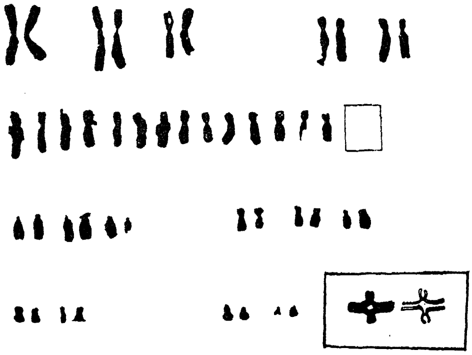


FIG. 1

The second exchange figure (Fig. 2) was from a female aged 32 years with a history of 8 repeated abortions, Fifty spreads were systematically scored for breaks, acentric fragments, etc. A total of 28% (14 in 50) aberrations were found. Out of these, 8 cells showed acentric fragments, large and small. The large ones were invariably tagged on to a B or C chromosome, while the small ones were often found free. No persistent deletion was seen that could account for the presence of fragments. In the cell showing the exchange figure, the deficiency in karyotype was in A3. The quadriradial that took its place was made up of 2 homologous chromosomes, equal in size and other features to the third pair in group A.

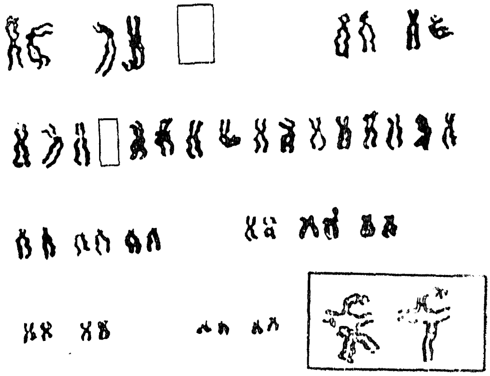


FIG. 2

Quadriradial exchange figures normally occur in meiosis and are the basis for the phenomenon of crossing-over. Such cross-overs in normal mitosis are rare. But Stern[3] has shown that they regularly occur in the somatic cells of drosophila. The same in mammalian species, especially man, is still in the realm of conjecture. Certain environmental agents like ionising radiation, virus and chemicals have been shown to increase the frequency of their appearance in mitotic cells.[4-6] Patau (*loc. cit.*) describes a normal female with two exchange figures in one cell and believes that one of them, the quadriradial having equal arms could be the result of somatic crossing-over. James German (*loc. cit.*) has documented a notable array of 21 such configurations in support of somatic crossing-over *in vitro*.

From a study of our cases, it seems to us that two points of view may be considered. Firstly, the quadriradial formation could be an *in vitro* somatic crossing-over. As in meiosis, the exchange seems to be non-random, having taken place between homologues and as also observed by James German—the points of breakage and union are near the secondary constriction.

The other observation of significance was the increased incidence of breaks. Hsu and Arrighi[7] believe that viral infections cause breaks in chromosomes which they term "not clean". These may unite in such translocations. That the quadriradial in our cases may be a chance rejoining of broken ends is less plausible, because, they are always between homologues and the exchange seems equal.

The chromosomes involved always being homologues and their points of breakage almost identical, giving rise to well-balanced quadriradial figures, are strongly in favour of the hypothesis of somatic pairing and crossing-over. But as the quadriradials have been found in individuals with more than normal % breaks, which we know are due to some change in mileu, one is tempted to wonder whether such somatic exchange could be taking place *in vivo* as the result of adverse environmental agents. Their absence from direct bone marrow preparations further strengthens this view.

Osmania Medical College, G. SADASIVAN.
Hyderabad, A.P., India, LILY N. EBENEZER.
September 29, 1969.

1. Patau, K., *Pathologie Biologie*, 1963, **11**, 1163.
2. German, James, *Science*, 1964, **144**, 298.
3. Stern, C., 1936, Cited by James German, 1964.
4. Court Brown, W. M., Buckton, K. E. and McLean, A. S., *Lancet*, 1965, **1**, 1239.
5. Nichols, W. W., Levan, A. and Kihlman, B. A., *Cytogenetic of Cells in Culture*, Ed. R. J. C. Harris, Academic Press, New York, 1964, p. 255.
6. Cohen, M. M., Marinello, M. J. and Back, Nathan, *Science*, 1967, **155**, 1417.
7. Hsu, T. C. and Arrighi, F. E., *In Vitro*, 1965, **1**, 67.

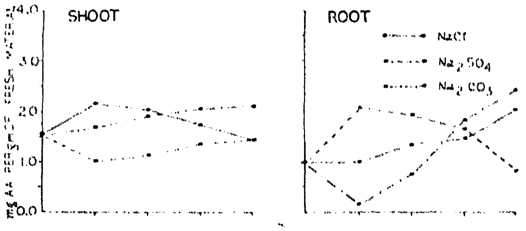
THE RELATIONSHIP BETWEEN SALT TOLERANCE AND ASCORBIC ACID CONTENT IN *PISUM SATIVUM* L. VARIETIES

THE increasing effect of sodium chloride and sodium sulphate at moderate doses on ascorbic acid content in cabbage and raddish is on record.[1] Polyanskaya[2] also reported that sodium chloride and sodium sulphate at moderate doses increased ascorbic acid content in cotton plants and at higher doses the vitamin level decreased, the decrease being greater with NaCl than with Na_2SO_4. Agarwala[3] has also recorded increased ascorbic acid content in barley plants raised on alkaline soils. Since, in the above experiments different species of plants have been used, no conclusive relationship could be drawn. In the present experiment two varieties of pea. *viz.*, Perfection and T-163 were grown in Petri-dishes over filter-paper using NaCl, Na_2SO_4 and Na_2CO_3 each at 3,000, 3,500, 4,000 and 4,500 ppm concentrations prepared in Hoagland's nutrient solution upto 10 days; the latter variety being slightly more salt tolerant.[4] Ascorbic acid content in the root and shoot-tips of both the varieties was determined by the method described by Chinoy *et al.*[5] using Beckman's spectrophotometer, model B.

The ascorbic acid (AA) content in the shoot of both the varieties was slightly more than one-and-a-half times greater than in their respective roots and the AA content of var. T-163 was almost double that in variety Perfection. With NaCl treatment, in both the varieties there was a regular increase in AA level in the roots, whereas in the shoots there was a considerable rise in AA at 3,000 ppm NaCl and then with further rise in salt concentration, the AA level went down steadily. With sulphate, however, there was a sudden rise in AA level at 3,000 ppm concentration in roots of both the varieties and then the AA level declined with further rise in salt concentration. In shoots, however, there was an initial fall at 3,000 ppm. Na_2SO_4 in T-163 and an initial steep rise in Perfection, and then gradual rise was maintained. With increasing Na_2CO_3 concentration, there was a steady and slow rise in the shoots, whereas in the roots there was a considerable initial set-back at 3,000 ppm and then the rise was maintained.

It is obvious from a comparison of the four graphs (Fig. 1) that in shoots at higher salt

ASCORBIC ACID CONTENT OF PEA var. T-163



ASCORBIC ACID CONTENT OF PEA var. PERFECTION

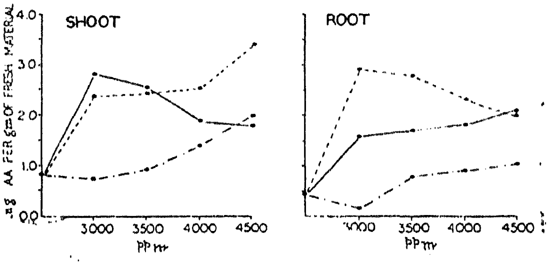


FIG. 1

concentrations the AA content has gone on increasing with sulphate and carbonate types of salinity but with NaCl it has decreased at higher concentrations, the peak being attained at a lower concentration. In roots, on the other hand, chloride and carbonate salts have gone on increasing AA concentration and sulphate, after recording a peak at 3,000 ppm resulted in a decline. Thus, a differing response of roots and shoots to salinity is obvious. Another fact is that, sulphate in the shoot of T-163 and carbonate in the shoot of Perfection maintained the AA levels at the bottom, whereas only carbonate is instrumental in the roots of both the varieties in keeping the AA level at the bottom.

Another important fact that emerges from this study is that there is considerable rise in the AA levels of both root and shoot of variety Perfection which is salt-sensitive,[4] whereas the variations in AA levels in variety T-163 which is slightly tolerant to salinity[4] are not that much. Thus, probably a variety, which is rich in AA and also has a better mechanism to maintain the AA level is more tolerant to salinity than a variety which is poor in AA and shows greater variations in AA content with salt treatments.

Dept. of Botany & Plant Path., U. S. Gupta.
Punjab Agricultural University, Parmil Kaur.
Hissar (India), *October* 9, 1969.

---

1. Kim C M, *Physiol. Plant.*, 1958, **11**, 44.
2. Polyanskaya L. A, *Izv. Akad. Nauk.*, 1962, **1**, 9.
3. Agarwala S C. *Rep. Indian Coun. Agric. Res. Scheme*, 1957 p 60
4. Parmil Kaur, *M.Sc. Thesis*, *P.A U.*, Hissar (India), 1968.
5. Chinoy, J J., Singh, N. and Sirohi, G. S., *Proc. Seminar Modern Developments in Plant Physiology*, Univ. Delhi, 1957, p 45.

REVIEWS AND NOTICES OF BOOKS

Annual Review of Biochemistry (Vol. 38). Edited by Esmond E. Snell. (Annual Reviews, Inc., 4139 El Camino Way, Palo Alto. California, U.S.A.), 1969. Pp. x + 1129. Price postpaid U.S.A. $11.50; Foreign $12.00.

Volume 38 of this well-known series contains the following articles: The Call of Science, by C. F. Cori; Enzymic Hydroxylation, by O. Hayaishi; Conformation of Polypeptide Chains, by C. M. Venkatachalam and G. N. Ramachandran; Polypeptide Hormones, by O. K. Behrens and E. L. Grinnan; Circulating Lipoproteins, by V. N. Schumaker and G. H. Adams; Circulating Lipoproteins, by V. N. Schumaker and G. H. Adams, Morris and I. K. Smith; Metabolism of Fatty Acids, by P. K. Stumpf; Catalytic Functions of Thiamin Diphosphate, by L. O. Krampitz; Synthetic Lipid Bilayer Membranes, by F. A. Henn and T. E. Thompson; Cell Membranes: Structure and Synthesis, by E. D. Korn; Biochemical Aspects of High-Resolution Mass Spectrometry, by G. VanLear and F. W. McLafferty; Regulation of Amino-Acid Metabolism, by H. E. Umbarger; Complex Heterosaccharides of Animals, by V. Ginsburg and E. F. Neufeld; Complement, by H. J. Muller-Eberhard; The Antibody Problem, by G. M. Edelman and W. E. Gall; DNA Modification and Restriction, by W. Arber and S. Linn; Structure and Biosynthesis of the Bacterial Cell Wall, by M. J. Osborn; Clinical Biochemistry: Enzymatic Methods: Automation and Atomic Absorption Spectroscopy, by W. E. C. Wacker and T. L. Coombs; Initiation and Control of DNA Synthesis, by K. G. Lark; Biochemistry of Learning: An Evaluation of the Role of RNA and Protein, by E. Glassman; Messenger RNA, by E. P. Geiduschek and R. Haselkorn; Ribonucleases, by E. A. Barnard; Chemical Approaches to the Properties of Active Sites of Enzymes, by B. L. Vallee and J. F. Riordan; Enzymes in DNA Metabolism, by C. C. Richardson; Recognition of Nucleotide Sequences, by M. Yarus; Chemical Synthesis of Peptides, by P. G. Katsoyannis and J. Z. Ginos; The Molecular Basis of Muscle Contraction, by M. Young; Chromosomal Proteins, by R. H. Stellwagen and R. D. Cole; and Oxidative Phosphorylation in Mitochondria, by H. A. Lardy and S. N. Ferguson. C. V. R.

Farmers of India, Volume IV. (Indian Council of Agricultural Research, Dr. Rajendra Prasad Road, Krishi Bhavan, New Delhi), 1968. Pp. xv + 318. Price Rs. 28·00.

The present volume is the fourth in the series of books on Farmers of India which the Indian

Council of Agricultural Research is bringing out to promote a fuller understanding of the farming communities in the country. It presents a panoramic view of the agricultural conditions obtaining in Madhya Pradesh, Rajasthan, Gujarat and Maharashtra and provides a succinct account of the topography, soils, climate, crops, agricultural practices, village organisation and folk culture of these States. The select photographs included in the book make the study more interesting. C. V. R.

The Invertebrates, Volume VI, *Mollusca I*. By Libbie H. Hyman. (McGraw-Hill Book Company, New York, St. Louis, San Francisco, Toronto, London, Sydney), 1968. Pp. vii + 792. Price $ 17.50.

The sixth volume in a series which has been internationally acclaimed a classic in its field, *Mollusca I* deals with four classes of molluscs: aplacophora, polyplacophora, monoplacophora, and gastropoda. For the author one of the world's leading invertebrate zoologists this is the final volume in an undertaking which began some 27 years ago. *Mollusca II*, Volume VII and the remaining volumes in the Invertebrate Series will be edited by Dr. Joel Hedgpeth of Oregon State Marine Science Laboratory, New Port, Oregon.

The contents of the volume are: The *Protostomatous coelomates*: *Phylum mollusca*: I. Historical; II. Characters of the Phylum; III. Classification of the Phylum; IV. Class Aplacophora; V. Class Polyplacophora; VI. Class Monoplacophora; VII. Class Gastropoda: Introduction; VIII. Class Gastropoda: Subclass Prosobranchia; IX. Class Gastropoda: Subclass Opisthobranchia; and X. Class Gastropoda: Subclass Pulmonata.

The volume will be found very useful to professional zoologists, teachers, graduate students, libraries, research institutions, and museums. C. V. R.

Structure and Stability of Biological Macromolecules (Volume 2 of *Biological Macromolecules Series*). Edited by S. N. Serge, N. Timasheff and Gerald D. Fasman. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. ix + 694. Price $ 33.50.

The vast research effort on macromolecules has led to the usual subdivision into many separate fields, such as nucleic acids, polysaccharides, and proteins. Increased understanding of such biological phenomena has brought the realization that these fields are truly interdisciplinary and the *Biological Macromolecules Series* has been designed to bridge the gaps of barriers between them. To this end, the series is devoted to the structural and conformational aspects of macromolecules and their relationships to function.

The current matter in Volume 2 has been dealt with under the following chapters: Theory of the Conformation of Biological Macromolecules in Solution, by [illegible]; Theoretical and Kinetic Aspects of Protein Conformation in Relation to Physiological Function, by Rufus Lumry and Rodney Biltonen; Conformations and Transitions of Proteins in Water and in Aqueous Mixtures, by John F. Brandts; The Conformation of [illegible] Structures in the Crystal and in Solution, by J. N. [illegible]; Conformation of [illegible] saccharides in Solution, by A. [illegible]; The Effect of Neutral Salts on the Structure and Conformational Stability of Macromolecules in Solution, by Peter H. von Hippel and Thomas Schleich; and Ultraviolet Spectra of Biological Macromolecules and Related Systems, by H. [illegible].

The series will be of interest to biochemists, polymer chemists, molecular biologists, biophysicists, physical chemists and spectroscopists.

C. V. R.

Yams. By D. G. Coursey. (Longmans, Green and Co. Ltd., 48 Grosvenor Street, London W. 1), Pp. 230. Price 63 sh.

This is a contribution under the *Tropical Agriculture Series*. It gives an account of the nature, origin, cultivation and utilization of the useful members of the [illegible].

Compared with other tropical crops the yams have not received adequate attention from research workers or scientific agriculturists although the yams provide the staple food for large populations in many tropical countries. The yams, as the word is widely understood, are all members of the monocotyledonous family Dioscoreaceae, and for the purpose of the book the author defines it as "Any of the economically useful plants of the botanical genus *Dioscorea* or the tubers or rhizomes of these plants."

The book is the first publication which attempts to bring together all important aspects so far known and scientifically studied on this tropical crop. The general survey includes, in separate chapters, the following: History and geography, Botany and taxonomy, concentrations the AA content has gone on increasing with sulphate and carbonate types of salinity but with NaCl it has decreased at higher concentrations, the peak being attained at a lower concentration. In roots, on the other hand, chloride and carbonate salts have gone on increasing AA concentration and sulphate, after recording a peak at 3,000 ppm resulted in a decline. Thus, a differing response of roots and shoots to salinity is obvious. Another fact is that, sulphate in the shoot of T-163 and carbonate in the shoot of Perfection maintained the AA levels at the bottom, whereas only carbonate is instrumental in the roots of both the varieties in keeping the AA level at the bottom.

Another important fact that emerges from this study is that there is considerable rise in the AA levels of both root and shoot of variety Perfection which is salt-sensitive,[4] whereas the variations in AA levels in variety T-163 which is slightly tolerant to salinity[4] are not that much. Thus, probably a variety, which is rich in AA and also has a better mechanism to maintain the AA level is more tolerant to salinity than a variety which is poor in AA and shows greater variations in AA content with salt treatments.

Dept. of Botany & Plant Path., U. S. GUPTA.
Punjab Agricultural University, PARMIL KAUR.
Hissar (India), *October* 9, 1969.

1. Kim. C M, *Physiol. Plant.*, 1958. **11**, 44.
2. Polyanskaya L. A, *Izv. Akad. Nauk.*, 1962, **1**, 9.
3. Agarwala S C. *Rep. Indian Coun. Agric. Res. Scheme*, 1957 p 60
4. Parmil Kaur, *M.Sc. Thesis*, *P.A U.*, Hissar (India), 1968.
5. Chinoy, J J., Singh, N. and Sirohi. G. S., *Proc. Seminar Modern Developments in Plant Physiology*, Univ. Delhi, 1957, p 45.

REVIEWS AND NOTICES OF BOOKS

Annual Review of Biochemistry (Vol. 38). Edited by Esmond E. Snell. (Annual Reviews, Inc., 4139 El Camino Way, Palo Alto. California, U.S.A.), 1969. Pp. x + 1129. Price postpaid U.S.A. $ 11.50; Foreign $ 12.00.

Volume 38 of this well-known series contains the following articles: The Call of Science, by C. F. Cori; Enzymic Hydroxylation, by O. Hayaishi; Conformation of Polypeptide Chains, by C. M. Venkatachalam and G. N. Ramachandran; Polypeptide Hormones, by O. K. Behrens and E. L. Grinnan; Circulating Lipoproteins, by V. N. Schumaker and G. H. Adams; Circulating Lipoproteins, by V. N. Schumaker and G. H. Adams, Morris and I. K. Smith; Metabolism of Fatty Acids, by P. K. Stumpf; Catalytic Functions of Thiamin Diphosphate, by L. O. Krampitz; Synthetic Lipid Bilayer Membranes, by F. A. Henn and T. E. Thompson; Cell Membranes: Structure and Synthesis, by E. D. Korn; Biochemical Aspects of High-Resolution Mass Spectrometry, by G. VanLear and F. W. McLafferty; Regulation of Amino-Acid Metabolism, by H. E. Umbarger; Complex Heterosaccharides of Animals, by V. Ginsburg and E. F. Neufeld; Complement, by H. J. Muller-Eberhard; The Antibody Problem, by G. M. Edelman and W. E. Gall; DNA Modification and Restriction, by W. Arber and S. Linn; Structure and Biosynthesis of the Bacterial Cell Wall, by M. J. Osborn; Clinical Biochemistry: Enzymatic Methods: Automation and Atomic Absorption Spectroscopy, by W. E. C. Wacker and T. L. Coombs; Initiation and Control of DNA Synthesis, by K. G. Lark; Biochemistry of Learning: An Evaluation of the Role of RNA and Protein, by E. Glassman; Messenger RNA, by E. P. Geiduschek and R. Haselkorn; Ribonucleases, by E. A. Barnard; Chemical Approaches to the Properties of Active Sites of Enzymes, by B. L. Vallee and J. F. Riordan; Enzymes in DNA Metabolism, by C. C. Richardson; Recognition of Nucleotide Sequences, by M. Yarus; Chemical Synthesis of Peptides, by P. G. Katsoyannis and J. Z. Ginos; The Molecular Basis of Muscle Contraction, by M. Young; Chromosomal Proteins, by R. H. Stellwagen and R. D. Cole; and Oxidative Phosphorylation in Mitochondria, by H. A. Lardy and S. N. Ferguson. C. V. R.

Farmers of India, Volume IV. (Indian Council of Agricultural Research, Dr. Rajendra Prasad Road, Krishi Bhavan, New Delhi), 1968. Pp. xv + 318. Price Rs. 28·00.

The present volume is the fourth in the series of books on Farmers of India which the Indian

Council of Agricultural Research is bringing out to promote a fuller understanding of the farming communities in the country. It presents a panoramic view of the agricultural conditions obtaining in Madhya Pradesh, Rajasthan, Gujarat and Maharashtra and provides a succinct account of the topography, soils, climate, crops, agricultural practices, village organisation and folk culture of these States. The select photographs included in the book make the study more interesting. C. V. R.

The Invertebrates, Volume VI, *Mollusca* I. By Libbie H. Hyman. (McGraw-Hill Book Company, New York, St. Louis, San Francisco, Toronto, London, Sydney), 1968. Pp. vii + 792. Price $ 17.50.

The sixth volume in a series which has been internationally acclaimed a classic in its field, *Mollusca I* deals with four classes of mollusks: aplacophora, polyplacophora, moncplacophora, and gastrcpoda. For the author—one of the world's leading invertebrate zoologists—this is the final volume in an undertaking which began some 27 years ago. *Mollusca* II, Volume VII and the remaining volumes in the Invertebrate Series will be edited by Dr. Joel Hodgpeth of Oregon State Marine Science Laboratory, New Port, Oregon.

The contents of this volume are: The *Protostomatous cœlomates—Phylum mollusca*: I. Historical; II. Characters of the Phylum; III. Classification of the Phylum; IV. Class Aplacophora; V. Class Polyplacophora; VI. Class Monoplacophora; VII. Class Gastropoda: Introduction; VIII. Class Gastropoda: Subclass Prosobranchia; IX. Class Gastropoda: Subclass Opisthobranchia; and X. Class Gastropoda: Subclass Pulmonata.

This volume will be found very useful by professional zoologists, teachers, graduate students, libraries, research institutions, and museums. C. V. R.

Structure and Stability of Biological Macromolecules (Volume 2 of *Biological Macromolecules Series*). Edited by S. N. Serge, N. Timasheff and Gerald D. Fasman. (Marcel Dekker, Inc., 95, Madison Avenue, New York). 1969. Pp. ix + 694. Price $ 33.50.

The vast research effort on macromolecules has led to the usual subdivision into many separate fields, such as nucleic acids, polysaccharides, and proteins. Increased understanding of such biological phenomena has brought the realization that these fields are truly interdisciplinary and the *Biological Macromolecules Series* has been designed to bridge the artificial barriers between them. To this end, the series is devoted to the structural and conformational aspects of macromolecules and their relationships to function.

The subject-matter in Volume 2 has been dealt with under the following chapters: Theory of the Conformations of Biological Macromolecules in Solution, by Howard DeVoe; Thermodynamic and Kinetic Aspects of Protein Conformations in Relation to Physiological Function, by Rufus Lumry and Rodney Biltenen; Conformational Transitions of Proteins in Water and in Aqueous Mixtures, by John F. Brandts; The Comparison of Protein Structure in the Crystal and in Solution, by J. A. Rupley; Conformations of Hexose Polysaccharides in Solutions. by A. L. Stone; The Effects of Neutral Salts on the Structure and Conformational Stability of Macromolecules in Solution, by Peter H. von Hippel and Thomas Schleich; and Infrared Spectra of Biological Macromolecules and Related Systems, by H. Susi.

This series will be of interest to biochemists, polymer chemists, molecular biologists, biophysicists, biologists, physical chemists, and spectroscopists.

C. V. R.

Yams. By D. G. Coursey. (Longmans, Green and Co. Ltd., 74. Grosvenor Street, London W. 1). Pp. 230. Price 63 *sh.*

This is a publication under the *Tropical Agricultural Series.* It gives an account of the nature, origins, cultivation and utilisation of the useful members of the Dioscoreaceæ.

Compared with other tropical crops the yams have not received adequate attention from research workers or scientific agriculturists, although the yams provide the staple foodstuff for large populations in many tropical countries. The yams, as the word is widely understood, are all members of the monocotyledonous family Dioscoreaceæ, and for the purpose of the book the author defines it as "any of the economically useful plants of the botanical genus *Dioscorea.* Or the tubers or rhizomes of these plants".

The book is the first publication which attempts to bring together all important aspects so far known and scientifically studied on this tropical crop. The general survey includes, in separate chapters, the following: History and geography, Botany and taxonomy, Agriculture, Pests and diseases, Production and utilisation, Nutrient values, Storage, transport and processing, Toxic and pharmacologically active constituents, and Social and cultural importance. The book, with its comprehensive coverage and literature references to original papers, will stimulate more intensive research on the subject and will appeal to agriculturists and scientists concerned with the production and utilisation of this crop. A. S. G.

Coasts and Beaches. (Contemporary Science Paperbacks No. 34). By J. A. Steers. (Oliver & Boyd Ltd., Tweeddale Court, 14, High Street, Edinburgh 1). Pp. 136. Price 7 *sh.* 6 *d.*

This introduction to coastal studies gives some notion of the width and ramifications of the subject. It has been written for the general reader as well as for the many people whose work is one way or another vitally concerned with the coast, and for whom it is advantageous that different approaches and points of view should be understood. It describes the practical applications of coastal studies and the researches necessary to enable us to understand a coast. Examples are taken from British Isles as well as from other countries. Besides twenty text-figures, the book contains a dozen halftone plates. A. S. G.

ANNOUNCEMENTS

International Symposium on Soil Fertility Evaluation

Under the joint auspices of the Indian Society of Soil Science, the Indian Society of Agronomy, the Indian Council of Agricultural Research, the Symposium will be held in New Delhi (India) from February 9 to 14, 1971.

Detailed information in the form of a brochure may be obtained from Dr. T. D. Biswas, Organizing Secretary, Symposium on Soil Fertility Evaluation, Indian Agricultural Research Institute, New Delhi-12.

Lady Tata Memorial Trust

Scholarships of Rs. 500 each per month and of Rs. 300 each per month, tenable for one year in the first instance, in India only, are offered to Indian Nationals. The Rs. 500 awards are open to post-graduate or graduate applicants with degrees in Medicine, of a recognised University. Rs. 300 awards are open also to those who hold a Master's degree in Science or who have graduated with distinction from a recognised University. The subject of investigation must have a bearing on the alleviation of human suffering from disease.

The last date for receiving the applications is 31st March 1970.

For further particulars apply immediately to the General Secretary, Lady Tata Memorial Trust, Bombay House, 24, Bruce Street, Fort. Bombay-1 BR.

Award of Research Degrees

Andhra University has awarded the Ph.D. degree in Applied Mathematics to Shri P. Gopala Krishna Murty; Ph.D. degree in Chemistry to Shri M. Pardhasaradhy; Ph.D. degree in Geology to Shri V. Divakara Rao and Shri R. V. Rama Rao.

Karnatak University, Dharwar, has awarded the Ph.D. degree in Physics to Shri R. C. Naik; Ph.D. degree in Mathematics to Shri K. A. Narayanan; Ph.D. degree in Chemistry to Shri I. S. Shenolikar; Ph.D. degree in Geology to Shri M. Ikramuddin.

The M.S. University of Baroda has awarded the Ph.D. degree in Mathematics to Shri O. S. Goyal; Ph.D. degree in Chemistry to Shri G. D. Bhat and Shri M. G. Parekh; Ph.D. degree in Geology to Shri Y. V. Deshpande; Ph.D. degree in Physics to Shri P. D. Patel; and Ph.D. degree in Statistics to Shri D. C. Mehta.

The Osmania University has awarded the Ph.D. degree in Mathematics to Shri B. N. Sreenivasa Rao; Ph.D. degree in Botany to Shri A. V. Lakshmi Narasimham and Shrimati Suryakanta.

Sri Venkateswara University, Tirupati, has awarded the Ph.D. degree in Zoology to Shri L. Ayub Khan and Shri Murali Krishna Dass.

The Utkal University has awarded the Ph.D. degree in Chemistry to Shri Durga Charan Pati, Shri Gopabandhu Behera and Shri A. K. Nayak.

Books Received

The World of Mars. By V. Axel Firsoff. (Oliver and Boyd Ltd., Tweeddale Court, Edinburgh 1), 1969. Pp. vi + 128. Price 7 *sh.* 6 *d.*

The Development of Astronomical Thought. By Patrick Moore. (Oliver and Boyd Ltd., Tweeddale Court, Edinburgh 1), 1969. Pp. vii + 119. Price 7 *sh.* 6 *d.*

Breeding Asian Field Crops. By J. M. Pochlman and D. Bortbakur. (Oxford and IBH Publishing Co., Park Hotel Building, Calcutta-16), 1969. Pp. 385. Price Rs. 18·00.

1787–70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

THE ACETYLCHOLINE-ATROPINE ANTAGONISM AS DETERMINED BY A SERIES OF pA VALUES[*]

M. B. GHARPURE
Medical College, Aurangabad

THOUGH Clark long time back (1926) showed that the acetylcholine-atropine antagonism is competitive in nature, there is no unanimity of opinion on this point. The author (1964) has summarized the varying view-points in this regard. Table I gives the findings of the various workers. This table has been reproduced from the author's previous article (1964). In that article, were reported the $pA_{5,000}$ and $pA_{25,000}$ values for the acetylcholine-atropine antagonism. That work was an attempt to settle the controversial point raised by the finding of Schild (1947) and Marshall (1955) that the acetylcholine-atropine antagonism is 'not-competitive' as judged from the pA_2 and pA_{10} values determined on the isolated guinea-pig ileum. The selection of the $pA_{5,000}$ and $pA_{25,000}$ values instead of pA_2 and pA_{10} values was not arbitrary. As explained in the above-referred article, the $pA_{5,000}$ and $pA_{25,000}$ values for the acetylcholine-atropine antagonism are roughly equivalent to the pA_2 and pA_{10} values for the histamine-atropine antagonism. However, the higher values determined did not clearly indicate that the acetylcholine-atropine antagonism is competitive.

TABLE I

Nature of acetylcholine-atropine antagonism

Authors	Nature of antagonism	Method	Test object
Clark, 1926 ..	Competitive	Concentration-action curves :— Plots, (i) log x : log $y/100-y$ (ii) log [atropine] : log [A – ch]	Frogs :— (*a*) Isolated ventricular strip (*b*) Isolated rectus abdominis muscle
Timms, 1956 ..	do.	log concentration-percentage action curves	Guinea-pig :—Isolated ileum
Schild, 1947 ..	Not competitive	pA method	do.
Marshall, 1955 ..	do.	do.	do.
Chen and Russell, 1950 ..	Not competitive (*see* Fig. No. 3 on page 144)	Lineweaver-Burk curves	Anaesthetized dogs :—Blood pressure response
Matsumoto and Kumoi, 1958	Not competitive [*see* Fig. 7 (III) on page 144]	do.	do.
Kirschner and Stone, 1951 ..	Not competitive (*see* Fig. No. 3 on page 828)	do.	Frogs :—Isolated rectus abdominis muscle

The present work is an extension of the previous one. Six different pA values, namely, pA_2, pA_{11}, pA_{101}, $pA_{1,001}$ $pA_{10,001}$ and $pA_{100,010}$ have been determined. In the pA method, that concentration of the antagonist is determined which reduces the response of some multiple of the original concentration (nx) to the response of the original concentration (x) of the agonist. Thus, the antagonist is counteracting $nx - x$ or $(n-1)x$ concentration of the agonist. From this, it can be easily seen that each higher value is differing from the lower one by a factor of 10.

The two additional values. namely, the $pA_{5,001}$ and $pA_{25,001}$ have also been determined.

METHOD

Essentially, the method described in detail in the earlier article (1964) was followed. The slight variations made are mentioned below :

(1) *The Apparatus.*—The whole set-up was the one associated with the automatic biological assay apparatus. However, as the timer was out of order, the operations such as emptying the bath and filling it with proper solutions were carried out manually. This was done by using bull-dog clamps on the rubber tubings on the drug reservoirs.

(2) *Drug Solutions.*—The stock solutions of both atropine sulphate and acetylcholine chloride were prepared in distilled water. They were preserved in a refrigerator. The necessay dilutions were made in the Tyrode solution, fresh, every day.

---

[*] Paper presented at the 35th Annual Meeting of the ndian Academy of Sciences, Aurangabad, Dec. 1969.

(3) *The Tyrode Solution.*—The composition of Tyrode solution used was as follows:

NaCl 0·8%; KCl 0·02%; $CaCl_2$ 0·01%; $MgCl_2$ 0·01%; $NaHCO_3$ 0·07% (In place of 0·1%); NaH_2PO_4 0·015% (In place of 0·005%); Glucose 0·1%. The pH of this Tyrode was 7·4. With the changes made in the concentrations of $NaHCO_3$ and NaH_2PO_4, there was no need to adjust the pH to 7·4 every day.

RESULTS

The results obtained in the present work are given in Tables II and III. In Table IV are reproduced some previous results. Table V compares some of the pA values from the two series worked out in the present work.

TABLE II

The pA values for the acetylcholine-atropine antagonism

Test Object: Isolated guinea-pig ileum.
Antagonism determined at 14 minutes.
+ = Competitive; x = 'not competitive'.
Test for competition:
$n = (10 + 10) - 2 = 18$; $P = 0·05$; $t = 2·10$.
Expected difference berween two consecutive values for competitive antagonism: 1·0 of a pA unit.

pA_x	pA_2	pA_{11}	pA_{101}	$pA_{1,001}$	$pA_{10,001}$	$pA_{100,001}$
pA value	8·82	8·06	7·07	6·01	4·90	3·94
St. dev.	0·189	0·085	0·143	0·211	0·111	0·086
n	10	10	10	10	10	10
Difference		0·76	0·99	1·06	1·11	0·96
+ or x		x	+	+	+	+
t		3·660	0·1901	0·7446	1·457	0·8993

TABLE III

The pA values for the acetylcholine-atropine antagonism

Test Object: Isolated guinea-pig ileum.
Antagonism determined at 14 minutes.
+ = Competitive; x = 'not competitive'.
Test for competition:
$n = (4 + 5) - 2 = 7$; $P = 0·05$; $t = 2·36$
Expected difference between the two values for competitive antagonism: 0·7 of a pA unit.

pA_x		$pA_{5,001}$	$pA_{25,001}$
pA value	..	5·24	4·41
St. dev.	..	0·187	0·092
n	..	4	5
Difference		0·83	
+ or x	..	+	
t	..	1·275	

TABLE IV

The pA values for the acetylcholine-atropine antagonism

Test Object: Isolated guinea-pig ileum.
Antagonism determined at 14 minutes.
+ = Competitive; x = 'not competitive'.
Test for competition:
$n = (4 + 4) - 2 = 6$; $P = 0·05$; $t = 2·45$.
Expected difference between the two values for competitive antagonism: 0·7 of a pA unit.

pA_x		$pA_{5,001}$	$pA_{25,001}$
pA value	..	5·44	4·62
St. dev.	..	0·042*	0·012
n	..	4	4
difference	..	0·82	
+ or x	..	†	
t	..	5·381	

*In the previous paper (1964) 0·012 was wrongly printed in place of 0·042.

† The difference is significantly higher than the expected difference of 0·7 of a pA unit. In the previous paper (1964) this was interpreted to indicate competitive antagonism.

TABLE V

The pA values for the acetylcholine-atropine antagonism

Test Object: Isolated guinea-pig ileum.
Antagonism determined at 14 minutes.
+ = Competitive; x = 'non competitive'.
Comparison of some pA values from the two series.

pA_x		$pA_{1,001}$	$pA_{5,001}$	$pA_{10,001}$	$pA_{25,001}$	$pA_{100,001}$
pA value	..	6·01	5·21	4·90	4·41	3·94
St. dev.	..	0·211	0·187	0·111	0·092	0·086
n	..	10	4	10	5	10
Difference	..		0·77	0·34	0·49	0·47
Expected difference			0·7	0·3	0·4	0·6
+ or x	..		+	+	+	x
t found out			0·6184	0·3909	1·686	2·680
t from the table			2·18	2·18	2·16	2·16

DISCUSSION

The results given in Table II very clearly indicate that while the antagonism is 'not competitive' at the level of pA_2-pA_{11}, it is competitive from the level of pA_{11}-pA_{101} to that of $pA_{10,001}$-$pA_{100,001}$. As there are six different pA values available, five tests for the nature of antagonism can be applied by comparing two consecutive pA values. The four out of these five tests make out the acetylcholine-atropine antagonism as competitive and only one makes it out as 'not competitive'. Thus, there is an overwhelming evidence in favour of the acetylcholine-atropine antagonism being competitive in nature as tested by the Schild's pA method on the isolated guinea-pig ileum. The comparison of the pA_2 and pA_{11} values shows that the antagonism is not competitive. This is in agreement with the findings of Schild (1947) and Marshall (1955). Why a compound like atropine which antagonizes acetylcholine competitively even at the level of its $pA_{10,001}$-$pA_{100,001}$ values does not do so at the lower level of its pA_2–pA_{10} (or pA_2-pA_{11}) values is difficult to understand. This is as yet an unsolved problem. The present work was not designed to find an explanation to this apparent discrepancy.

The author (1964) for the first time determined such high values as $pA_{5,000}$ and $pA_{25,000}$ in the study of drug antagonism. In the present work, the highest pA value determined is even higher than the one previously determined, namely, $pA_{25,000}$. One possible objection to testing very high concentrations of an antagonist is that at high concentrations, it may exert a non-specific action. This is a distinct theoretical possibility to be borne in mind. However, it must be proved to apply in a given instance. In the case of a truly competitive and highly specific compound, it may not apply. From the present work, it appears that such is the case with atropine for its acetylcholine antagonism.

In the present work, pA_2, pA_{11}, pA_{101}, $pA_{1,001}$, $pA_{10,001}$ and $pA_{100,001}$ values have been determined and not pA_2, pA_{10}, pA_{100}, $pA_{1,000}$, $pA_{10,000}$ and $pA_{100,000}$. This change is only a finer refinement in the pA method. The expected differences between pA_2 and pA_{10} and pA_2 and pA_{11} for competitive antagonism are respectively 0·9542 and 1·0000 of a pA unit. Handling the integral is easier than the fraction. Hence the change was made.

The $pA_{5,000}$ and $pA_{25,000}$ values determined previously had not unequivocally indicated that the acetylcholine-atropine antagonism is competitive. Therefore, along with the above-referred series of pA values, these values were repeated. Actually, however, the values determined were $pA_{5,001}$ and $pA_{25,001}$ to be in line with the first series of the pA values.

The results of this work are given in Table III. For the sake of comparison, the previously determined $pA_{5,000}$ and $pA_{25,000}$ values are reproduced in Table IV. The comparison of the $pA_{5,001}$ and $pA_{25,001}$ values shows that the antagonism is competitive. However, the comparison of the $pA_{5,000}$ and $pA_{25,000}$ values had not clearly indicated the presence of competition. The difference between the two values was significantly higher than the expected difference of 0·7 of a pA unit. This was provisionally interpreted as indicating competitive antagonism. The difference in the two sets of results emphasizes that four observations may not be adequate. The smaller the interval between the pA values compared, greater should be the number of observations. In the present work, though only four observations have been made for $pA_{5,001}$ and $pA_{25,001}$ values, for the series of six values between pA_2 and $pA_{100,001}$, ten observations have been made for each pA value. By interposing the $pA_{5,001}$ and $pA_{25,001}$, values in the first series of the pA values some more comparisons and therefore some more tests for the nature of the antagonism are available. Table V gives these comparisons. Three out of the four tests available make out the antagonism as competitive. This is an added support to the conclusion arrived at from the present work that the acetylcholine-atropine antagonism is competitive in nature as tested on the isolated guinea-pig ileum, by the pA method. The fact that one of the tests is falling out of line may be explained, as discussed above, on the basis of five determinations for $pA_{25,001}$ values being not adequate. It is to be noted that $pA_{100,001}$ value differs from the $pA_{25,001}$ by a factor of 4.

ACKNOWLEDGEMENT

The technical assistance of Mr. N. A. Utpat, Mr. V. G. Hirve and Miss Jaidesh Chandhok is gratefully acknowledged. Thanks are due to Mr. Abdul Hameed for typing the manuscript.

---

1. Chen, G. and Russell, D., *Jour. Pharmacol.*, 1950, **99**, 401.
2. Clark, A. J., *Jour. Physiol.*, 1926, **61**, 547.
3. Gharpure, M. B, "An assessment of three methods for the experimental study of during antagonism," *Thesis* for the M.Sc. degree of St. Andrews University (U.K.), 1961.
4. —, *Ind. Jour. Med. Res.*, 1964, **52**, 194.
5. Kirschner, K. B. and Stone, W. E., *Jour. Gen. Physiol.*, 1951, **34**, 821.
6. Marshall, P. B., *Brit. Jour. Pharmacol.*, 1955, **10**, 354.
7. Matsumoto, H. and Kumoi, T., *Kobe Jour. Med. Sci.*, 1958, **4**, 139.
8. Schild, H. O., *Brit. Jour. Pharmacol.*, 1947, **2**, 189.
9. Timms, A. R., *Ibid.*, 1956, **11**, 273.

THE PRODUCTION OF A THELYTOKOUS HYBRID IN AN INTERSPECIFIC CROSS BETWEEN TWO SPECIES OF *TRICHOGRAMMA* (HYM. : TRICHOGRAMMATIDAE)*

SUDHA NAGARKATTI

Indian Station, Commonwealth Institute of Biological Control, Bangalore, India

AS discussed by Mayr (1963), the occurrence of animal hybrids in nature is relatively rare, but in the laboratory where isolating mechanisms can sometimes be overcome, two species which normally do not hybridize in nature can be induced to do so. Most interspecific hybridization studies involving insects have dealt with *Drosophila* (*e.g.*. Patterson and Stone, 1952) or mosquitoes (*e.g.*, Laven, 1959), while some work has also been done with Coleoptera (Smith, 1959 and 1962).

Recent work done with *Aphytis* spp. (Hymenoptera, Aphelinidæ) by Rao and DeBach (1969 *a*, 1969 *b*) has shown some interesting possibilities in parasitic Hymenoptera, including the production of substantial degrees of reproductive isolation in a single step between hybrids in certain interspecific crosses and the parental species (Rao and DeBach, 1969 c). These authors have suggested that such hybrids could be considered to be semispecies, in view of their being partially reproductively isolated from their parent species and further that if complete reproductive isolation had been encountered, the hybrids would then qualify for species status. The production of such "laboratory-created species" of parasitic insects would be of special interest to biological control workers, since introduction of such a "species" having an altogether different genotype and possibly also different biological characteristics would be equivalent to introducing an exotic species.

During the course of interspecific hybridization experiments with egg parasites of the genus *Trichogramma*, a single "hybrid" was obtained which seemed to be unique. The two species used in this particular cross were biparental and arrhenotokous, so that any females in the F_1 generation were believed to be unquestionably hybrid. (The possibilities of these *not* being hybrids is discussed later.) The cross involved females of *T. perkinsi* Gir., a parasite of *Diatræa saccharalis* (F.) in Colombia (South America) and males of *T.* D-67, a parasite of *Hemerocampa pseudotsugota* McD. in north-eastern California. Th identity of the latter is not quite clear as ye hence a code name is being used. Five vial each with 5 virgin females of *T. perkinsi* an 2–3 males of *T.* D-67 were prepared for mating. Extreme care was taken to see that th cultures were pure and that no *perkinsi* male had access to the *perkinsi* females used in th experiment. To ensure their virginity, female from individually isolated parasitized eggs o the laboratory host, *Corcyra cephalonica* Staint were used. The cross was set up in the manner described by Nagarkatti and Nagaraj (1968), the progeny being isolated after egg of *Corcyra* had been parasitized.

A total of 17 females ("hybrids") were obtained in the F_1 generation. As had been standard practice, a single virgin "hybrid" femal was given host eggs for parasitization with : view to obtaining hybrid males, while the remaining "hybrid" females were kept separately Surprisingly, all the progeny produced by the single virgin female proved to be *females* and not males as had been expected. The F_2 progeny and the offspring in each subsequent generation of this single individual have all demonstrated thelytoky, whereas all the remaining 7 F_1 females (9 females out of the 17, died before they could be tested) proved to be arrhenotokous.

Amongst possible explanations which can be proposed for this phenomenon, are the following:

1. That thelytoky was produced as a result of hybridization. Certain genetic changes, as yet undetermined, may have been responsible for the development of thelytoky in the F_1 female.

2. That the female was not really a hybrid, but an impaternate female that was produced from patches of tetraploid ovarian tissue in the parental *T. perkinsi* female. This phenomenon has been reported by Speicher and Speicher (1938) in the F_1 from crosses between certain mutants of *Habrobracon juglandis* (Ashmead). In *Habrobracon*, the F_1 females apparently produce a small proportion of females regularly, which originate from tetraploid tissue in the parental female.

---

* This research has been financed in part by a grant made by the United States Department of Agriculture under P.L. 480.

3. That other mechanisms were responsible for restoration of diploidy, such as fusion of products of meiosis or fusion of cleavage nuclei.

It is not known whether there occur in the ovaries of any species of *Trichogramma*, much less of *T. perkinsi*, patches of tetraploid tissue, which could possibly have given rise to the single thelytokous female. This will have to be determined by isolating very large numbers of *T. perkinsi* and checking the progeny of unmated virgin females for any rare parthenogenetically produced females. On the basis of experience, however, this seems very unlikely. The cytology of these insects is so poorly understood, and since the chromosomes are extremely small, detection of any genetic change becomes difficult. Preliminary studies to see whether the hybrids are polyploids have indicated that they are not. At present, therefore, the alternative explanations given above seem equally probable and there could [illegible] as well as others.

The interesting fact is the thelytokous female is indeed of hybrid origin, so that a line derived from the female would be equivalent to a 'thelytokous hybrid species', as the individuals would then seem to have a genetic make-up quite unlike that of either of the parent species, although phenotypically they may be identical to their paternal parent as has been found to be true of all *Trichogramma*. Further interest is attached [illegible] the authors [illegible] any thelytokous and removal gene combination would be reproduced faithfully generation after generation. This statement would, of course, also hold true for any deleterious gene combinations, and if such should be present the isolated line would peter out in due course. As pointed out by [illegible] (19[illegible]), although apomixis confers certain advantages on a species, its evolutionary future is [illegible] thwarted.

Flanders (1945) has stated that thelytoky occurs in any species of *Trichogramma* and [illegible] in some species due to sporadic and conditioned by [illegible] factors. But we do not really know how frequently a biparental species produces uniparental clones. Attempts are being made by the author to determine this in the case of *T. perkinsi*. The 5,932 progeny of 101 virgin, unmated *perkinsi* females have, however, proved to be exclusively male. If the incidence rate is one in ten million or even one in a million it would scarcely be feasible to determine this.

Records of the [illegible] origin of thelytokous strains of species of [illegible] Hymenoptera appear to be [illegible]. Wheeler and Phillips (1946) have [illegible] the occurrence of [illegible] of *T.* [illegible] which [illegible] females of the normally biparental species. [illegible] progeny of unmated [illegible] females were [illegible] in the [illegible]. [illegible] were [illegible]. The progeny of 44 of these proved to be entirely male, but 3 of the remaining 4 virgin females produced a small proportion of [illegible] females amongst the otherwise predominantly male progeny (?). Of these three [illegible] the offspring from one female were [illegible]; further, the offspring of the [illegible] female became all males in the second generation, all eventually [illegible] in the third generation. It therefore appears that the ability to reproduce [illegible] parthenogenetically did not last more than one or two generations [illegible] in the case of the *Trichogramma* [illegible]. Wheeler and Phillips say that, "While the conditions under which these experiments were conducted [illegible] natural conditions [illegible], it could very easily [illegible] that there are very few [illegible]. The apparently [illegible] feature that would [illegible] the species as being [illegible] rate [illegible] of [illegible]."

ACKNOWLEDGEMENTS

The author is thankful to Mr. H. Nagaraja, CIBC Indian Station, for setting up the [illegible] and [illegible] maintaining the hybrid cultures, and to Dr. H. Sharat Chandra and his colleagues of the Institute for Genetic Studies, Bangalore, for determining the non-polyploid nature of the [illegible]. He is also grateful to Prof. M. J. D. White of the University of Melbourne and Prof. Ernst Mayr of Harvard University for critically reviewing the manuscript and making helpful suggestions. The encouragement given by Dr. F. J. Simmonds, Director, CIBC, and Dr. V. P. Rao, Entomologist-in-charge, CIBC Indian Station, in making the study is gratefully acknowledged.

1. Flanders, S. E., "The bisexuality of uniparental Hymenoptera, a function of the environment," *Amer. Nat.*, 1945, 79, 122.
2. Laven, Hannes, "Speciation by cytoplasmic isolation in the *Culex pipiens* complex," *Cold Spring Harb. Symp. quant. Biol.*, 1959, 24, 166.

THE PRODUCTION OF A THELYTOKOUS HYBRID IN AN INTERSPECIFIC CROSS BETWEEN TWO SPECIES OF *TRICHOGRAMMA* (HYM. : TRICHOGRAMMATIDAE)*

SUDHA NAGARKATTI

Indian Station, Commonwealth Institute of Biological Control, Bangalore, India

As discussed by Mayr (1963), the occurrence of animal hybrids in nature is relatively rare, but in the laboratory where isolating mechanisms can sometimes be overcome, two species which normally do not hybridize in nature can be induced to do so. Most interspecific hybridization studies involving insects have dealt with *Drosophila* (*e.g.*. Patterson and Stone, 1952) or mosquitoes (*e.g.*, Laven, 1959), while some work has also been done with Coleoptera (Smith, 1959 and 1962).

Recent work done with *Aphytis* spp. (Hymenoptera, Aphelinidæ) by Rao and DeBach (1969 *a*, 1969 *b*) has shown some interesting possibilities in parasitic Hymenoptera, including the production of substantial degrees of reproductive isolation in a single step between hybrids in certain interspecific crosses and the parental species (Rao and DeBach, 1969 *c*). These authors have suggested that such hybrids could be considered to be semispecies, in view of their being partially reproductively isolated from their parent species and further that if complete reproductive isolation had been encountered, the hybrids would then qualify for species status. The production of such "laboratory-created species" of parasitic insects would be of special interest to biological control workers, since introduction of such a "species" having an altogether different genotype and possibly also different biological characteristics would be equivalent to introducing an exotic species.

During the course of interspecific hybridization experiments with egg parasites of the genus *Trichogramma*, a single "hybrid" was obtained which seemed to be unique. The two species used in this particular cross were biparental and arrhenotokous, so that any females in the F_1 generation were believed to be unquestionably hybrid. (The possibilities of these *not* being hybrids is discussed later.) The cross involved females of *T. perkinsi* Gir., a parasite of *Diatræa saccharalis* (F.) in Colombia (South America) and males of *T.* D-67, a parasite of *Hemerocampa pseudotsugota* McD. in north-eastern California. The identity of the latter is not quite clear as yet, hence a code name is being used. Five vials, each with 5 virgin females of *T. perkinsi* and 2-3 males of *T.* D-67 were prepared for mating. Extreme care was taken to see that the cultures were pure and that no *perkinsi* males had access to the *perkinsi* females used in the experiment. To ensure their virginity, females from individually isolated parasitized eggs of the laboratory host, *Corcyra cephalonica* Staint., were used. The cross was set up in the manner described by Nagarkatti and Nagaraja (1968), the progeny being isolated after eggs of *Corcyra* had been parasitized.

A total of 17 females ("hybrids") were obtained in the F_1 generation. As had been standard practice, a single virgin "hybrid" female was given host eggs for parasitization with a view to obtaining hybrid males, while the remaining "hybrid" females were kept separately. Surprisingly, all the progeny produced by the single virgin female proved to be *females* and not males as had been expected. The F_2 progeny and the offspring in each subsequent generation of this single individual have all demonstrated thelytoky, whereas all the remaining 7 F_1 females (9 females out of the 17, died before they could be tested) proved to be arrhenotokous.

Amongst possible explanations which can be proposed for this phenomenon, are the following:

1. That thelytoky was produced as a result of hybridization. Certain genetic changes, as yet undetermined, may have been responsible for the development of thelytoky in the F_1 female.

2. That the female was not really a hybrid, but an impaternate female that was produced from patches of tetraploid ovarian tissue in the parental *T. perkinsi* female. This phenomenon has been reported by Speicher and Speicher (1938) in the F_1 from crosses between certain mutants of *Habrobracon juglandis* (Ashmead). In *Habrobracon*, the F_1 females apparently produce a small proportion of females regularly, which originate from tetraploid tissue in the parental female.

---

* This research has been financed in part by a grant made by the United States Department of Agriculture under P.L. 480.

3. That other mechanisms were responsible for restoration of diploidy, such as, fusion of products of meiosis or fusion of cleavage nuclei.

It is not known whether there occur in the ovaries of any species of *Trichogramma,* much less of *T. perkinsi,* patches of tetraploid tissue, which could possibly have given rise to the single thelytokous female. This will have to be determined by isolating very large numbers of *T. perkinsi* and checking the progeny of unmated (virgin) females for any rare parthenogenetically-produced females. On the basis of past experience, however, this seems very unlikely. The cytology of these insects is also poorly understood, and since the chromosomes are extremely small, detection of any genetic changes becomes difficult. Preliminary studies to see whether the hybrids are polyploids have indicated that they are not. At present, therefore, the alternative explanations given above seem equally probable and there could very well be others.

The interesting fact, *if* the thelytokous female is indeed of hybrid origin, is that, a line derived from this female would be equivalent to a "laboratory-created species", as the individuals would then obviously have a genetic make-up quite unlike that of either of the parent species, although phenotypically they may be identical to their maternal parent (as has been found to be true of all *Trichogramma* hybrids hitherto observed by the author). Being thelytokous, any beneficial gene combinations would be reproduced faithfully generation after generation. This statement would, of course, also hold true for any deleterious gene combinations, but if such should be present, the ill-adapted line would peter out in any event. As pointed out by Rollins (1967), although apomixis confers certain advantages on a species, its evolutionary future is pretty well thwarted.

Flanders (1945) has stated that thelytoky may occur in any species of *Trichogramma* and its occurrence in some species may be sporadic and conditioned by undetermined environmental factors. But we do not really know how frequently a biparental species produces uniparental clones. Attempts are being made by the author to determine this in the case of *T. perkinsi.* The 5,932 progeny of 101 virgin (unmated) *perkinsi* females have, however, proved to be exclusively male. If the number is as rare as one in ten million or even one in a million, it would scarcely be feasible to determine this.

Records of sporadic production of thelytokous individuals in species of arrhenotokous Hymenoptera appear to be few and far between. Webster and Phillips (1912) have reported the work of Messrs. Kelly and Urbahns on *Lysiphlebus* (*Aphidius*) *testaceipes* Cress. in which females were produced parthenogenetically by the normally biparental species. The progeny of a single mated female were isolated by them in the pupal stage. From these, 48 virgin females were selected for study. The progeny of 44 of these proved to be entirely male, but 3 of the remaining 4 virgin females produced a small proportion of (10) females amongst the otherwise predominantly male progeny (238). Of these three cases, the offspring from one female were not checked further; the offspring of the second female became all males in the second generation, all eventually becoming males in the third generation. It, therefore, appears that the ability to reproduce female offspring parthenogenetically did not last for more than one or two generations, as it did in the case of the *Trichogramma.* Commenting on these results, Webster and Phillips say that, "While the conditions under which these experiments were conducted would not obtain under ordinary field conditions where the infestation was great, it could very easily occur where there are very few aphids present. This apparently abnormal feature, then, would greatly assist the species in tiding over periods of scarcity of plant-lice."

ACKNOWLEDGEMENTS

The author is thankful to Mr. H. Nagaraja, CIBC Indian Station, for setting up the original crosses and maintaining the hybrid cultures and to Dr. H. Sharat Chandra and his colleagues of the Institute for Genetic Studies, Bangalore, for determining the non-polyploid nature of the hybrids. She is also grateful to Prof. M. J. D. White of the University of Melbourne, and Prof. Ernst Mayr of Harvard University, for critically reviewing the manuscript and making useful suggestions. The encouragement given by Dr. F. J. Simmonds, Director, CIBC, and Dr. V. P. Rao, Entomologist-in-Charge, CIBC Indian Station, in making this study, is also gratefully acknowledged.

---

1. Flanders, S. E., "The bisexuality of uniparental Hymenoptera, a function of the environment," *Amer. Nat.*, 1945, **79**, 122.
2. Laven, Hannes, "Speciation by cytoplasmic isolation in the *Culex pipiens* complex," *Symposia on Quantitative Biol.*, 1959, **24**, 166.

3. Mayr, Ernst, *Animal Species and Evolution*, Harvard Univ. Press, 1963, p. 797.
4. Nagarkatti, Sudha and Nagaraja, H., "Biosystematic studies on *Trichogramma* species : I. Experimental hybridization between *Trichogramma australicum* Girault, *T. evanescens* Westwood and *T. minutum* Riley," *Commw. Inst. biol. Centr. Tech. Bull.*, 1968, **10**, 81.
5. Patterson, J. T. and Stone, W. S., *Evolution in the Genus Drosophila*, The Macmillan Company, New York, 1952, p. 610.
6. Rao, Sudha, V. and DeBach, Paul, "Experimental studies on hybridization and sexual isolation between some *Aphytis* species (Hymenoptera : Aphelinidæ). I. Experimental hybridization and interpretation of evolutionary relationships between the species," *Hilgardia*, 1969 *a*, **39** (19), 515.
7. —, — and —, "Experimental studies on hybridization and sexual isolation between some *Aphytis* species (Hymenoptera : Aphelinidæ). II. Experiments on sexual isolation," *Ibid.*, 1969 *b*, **39** (19), 555.
8. Rao, Sudha, V. and DeBach Paul, "Experimental studies on hybridization and sexual isolation between some *Aphytis* species (Hymenoptera : Aphelinidæ). III. The significance of reproductive isolation between interspecific hybrids and parental species," *Evolution*, 1969*c*, **23** (4).
9. Rollins, R. C., "The evolutionary fate of inbreeders and non-sexuals," *Amer. Nat.*, 1967, **101**, 343.
10. Smith, Stanley, G., "The cytogenetic basis of speciation in Coleoptera," *Proc. X Internatl. Congr. Genetics*, (1956), 1959, **1**, 444.
11. —, —, "Cytogenetic pathways in beetle speciation," *Canad. Ent.* 1962, **94** (9), 941.
12. Speicher, Kathryn, G. and Speicher, B. R., "Diploids from unfertilized eggs in *Habrobracon*," *Biol. Bull.*, 1938, **74**, 247.
13. Webster, F. M. and Phillips, W. J., "The spring grain-aphis or green bug," *U.S. Dept. Agric. Tech. Bull. No. 110*, 1912.

PSEUDODIAPTOMUS JONESI, A NEW CALANOID COPEPOD FROM INDIAN WATERS*

P. PARAMESWARAN PILLAI**

Central Marine Fisheries Research Institute, Mandapam Camp

INVESTIGATIONS carried out on the Calanoid Copepoda of the family Pseudodiaptomidæ of the Indian Ocean reveal that so far twenty-one species and one sub-species have been described or recorded from this area (Sewell[1,2]; Brehm[3-5]; Nicholls[6]; Tanaka[7]; Ummerkutty[8]; Desai and Bal[9]; Grindley[10]; Wellershaus[11]; Grice[12]). These are : *Pseudodiaptomus annandalei* Sewell (= *P. dubius* Kiefer ; = *P. nostradamus* Brehm) ; *P. aurivillii* Cleve ; *P. ardjuna* Brehm ; *P. binghami* Sewell ; *P. binghami malayalus* Wellershaus ; *P. batillipes* Brehm ; *P. burckhardti* Sewell ; *P. clevei* A. Scott ; *P. charteri* Grindley ; *P. cornutus* Nicholls ; *P. dauglishi* Sewell ; *P. heterothrix* Brehm ; *P. hickmani* Sewell ; *P. lobipes* Gurney ; *P. masoni* Sewell ; *P. marinus* Sato ; *P. mertoni* Fruchtl ; *P. pauliani* Brehm ; *P. salinus* (Giesbrecht) ; *P. serricaudatus* (T. Scott) (= *P. nudus* Tanaka) ; *P. stuhlmanni* (Poppe and Mrazeck) and *P. tollingeræ* Sewell. While examining material of Pseudodiaptomidæ from Indian waters a hitherto undescribed species has been encountered in the samples collected from Cochin Backwaters and Palk Bay and this paper embodies a description of the new species.

Pseudodiaptomus jonesi SP. NOV.

(FIG. 1 *a–l*)

Pseudodiaptomus ardjuna (*nec.* Brehm, 1953) Wellershaus, 1969, pp. 259, 262 ; Fig. 24.

Material.—Collections obtained by horizontal tows along surface by 50 cm. diameter conical net as follows : (1) *Cochin Backwaters* : 17–12–1968, between 07·50–08·00 hr. (4 M, 12 F) ; 21–1–1969, between 08·03–08·13 hr. (6 F) ; 4–2–1969, between 07·40–07·50 hr. (1 M) ; 11–2–1969, between 08·10–08·20 hr. (6 M, 4 F) ; 18–3--969, between 08·00–08·10 hr. (6 M, 6 F) ; 11–3–1969, between 08·00–08·10 hr. (1 M, 1 F) : (2) *Palk Bay* : 22–6–1959, between 06·00–06·15 hr. (10 M, 20 F).

Type material.—*Holotype*, C.M.F.R.I. No. 151. Female, 1·180 mm., and *Allotype*, C.M.F.R.I. No. 152. Male, 0·968 mm., both from Cochin Backwaters collected on 18–2–1969 from surface. *Paratypes* C.M.F.R.I. No. 153, include 55 adults (31 F, 24 M) collected on 4, 11 and 18 February and 11 March 1969 from Cochin Backwaters and on 22 May 1969 from Palk Bay as listed above. Type specimens are deposited in the Research Collections of Central Marine Fisheries Research Institute, Mandapam Camp.

Description.—*Female* : Total length for 33 adults range 1·14–1·18 mm., with mean length 1·16 mm. ; Cephalon distinct from T-I and is

---

* Published with the permission of the Director, C.M.F.R. Institute, Mandapam Camp.

** Present address : C.M.F.R. Sub-Station, Gopala Prabhu Cross Road, Ernakulam, Cochin-11.

bluntly rounded anteriorly; T-IV and T-V fused, with posterior corners obtuse; rostrum filamentous, directed ventro-posterad; four-segmented urosome with caudal rami showing proportionate lengths = 25 : 18 : 24 : 13 : 20%; genital segment ventrally produced, with patches of small spinules arranged asymmetrically and with a perceptible marginal indentation at its right dorsal margin; dorsally a group of spinnules also present extending to right proximal margin; ventrally two rows are present anterad and posterad to genital opercular flap; two small setæ present on either side of paired genital pores; postero-dorsal margins of U-I to U-III beset with small triangular spikes, those on the latter larger; U-IV dorsally at its postero-lateral angles with finely serrated shields, overlapping a small portion of caudal rami; latter symmetrical, ratio of L : W = 2·8 : 1; each ramus with one apical and five marginal setæ; A-1 with 21 segments, reaches to middle of genital segment, with partial to complete fusion between segments 4–10 and 24–25 and with the following proportionate lengths:

Seg.	1	2	3	4	5	6	7	8	9	10	11
%	5·1	4·5	2·7	3·5	3·0	4·7	2·4	2·8	4·7	5·2	5·6
Seg.	12	13	14	15	16	17	18	19	20	21	
%	6·0	6·3	6·5	6·6	5·6	4·4	4·5	5·0	5·2	5·6	

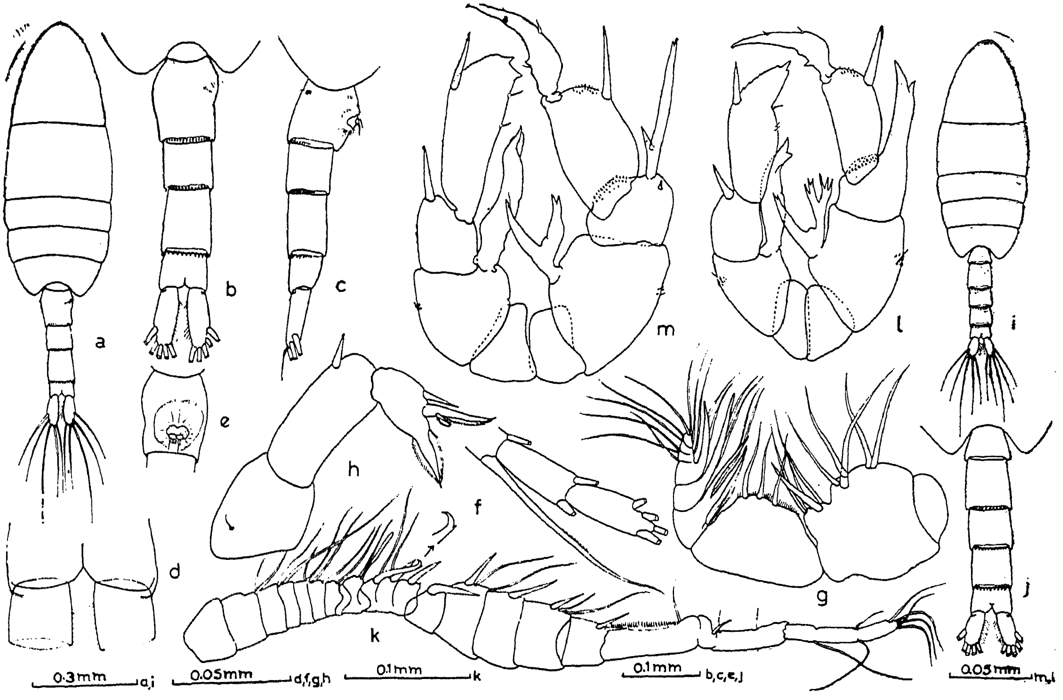


FIG. 1. *Pseudodiaptomus jonesi* sp. nov., Female: *a*, dorsal view; *b*, urosome, dorsal view; *c*, urosome, lateral view; *d*, posterior margin of U-IV, dorsal view; *e*, genital segment, ventral view; *f*, A-1 segments 19-21 with modified seta on segment 19; *g*, Mxp; *h*, P-5. Male: *i*, dorsal view; *j*, urosome, dorsal view; *k*, right geniculate A-1; *l*, P 5. *Pseudodiaptomus ardjuna* Brehm; *m*, Male P-5.

A-1 segment 19 having specialised seta with 8–9 small spinnules along its mid inner margin; A-2, Mnd and Mx_1 as in *P. ardjuna*; Mx_2 and Mxp with hook-like additional spines on first three endites, with that on first endite on Mxp bifurcate; P-1 to P-4 with three-segmented Ri and Re, with arrangement of setæ and spines as given for *P. ardjuna* by Ummerkutty[8]; P-5 as in *P. ardjuna* having distal Re segment with three spines, two of which are subequal and inner distal spine flat and serrated along both margins; Re_1 with a distal outer spine showing slight difference in ratio of L : W being 2·5 : 1 (*versus* 3·0 : 1 in *P. ardjuna*).

Male : Total length for 28 adults range 0·96–0·98 mm., with mean length 0·97 mm. ; T-V posteriorly obtuse ; five-segmented urosome with caudal rami showing proportionate lengths = 11 : 26 : 17 : 17 : 12 : 17% ; U-I short, devoid of dorsal spikes ; U-II to U-IV with rows of small triangular spikes as in female ; U-V with serrated shield as in female ; caudal rami symmetrical, its ratio of L : W = 2·5 : 1 ; geniculate right A-1 with 19 segments ; four large spines one each on segments 10–13, that on segment 10 being longer and recurved at its tip with a small secondary spike ; segments 14–16 enlarged each with a slender spine dorsally ; serrated plate on segment 18 with minute villiform teeth ; distal to hinge three segments present, but segmentation indistinct between terminal and penultimate segments. *Fifth legs* : Right P-5 with B_2 slightly longer than wide and with a row of minute spines along its outer mid margin ; B_2 produced at proximal inner margin into a bifurcated process with antler-like arms of unequal length and construction ; inner ramus still further branched into two processes, each distally tridentate ; outer ramus is asymmetrically bifid at tip ; Re_1 as long as wide and dentate along its oblique distal edge and produced into an outer, large broad spine extending upto the distal margin of Re_2 and tapering towards extremity ; lateral spine of Re_1 asymmetrically bifid distally (at its 4/5th distal length) ; Re_2 with L : W ratio = 2 : 1, and provided with a long distal outer marginal spine 30% length of lateral spine of Re_1 ; a few small spinnules present between former and base of Re_3 ; Re_3 sickle-shaped, with two blunt outgrowths along inner margin towards base and two setæ placed equidistant along outer margin ; left P-5 with B_2 longer than broad and with a set of small lateral spines on its outer margin ; B_2 produced at inner distal margin into a digitiform curved process which reaches middle of Re_2 ; Re_1 with a stout spine at outer distal corner which exceeds 50% length of segment ; Re_{2-3} fused, forming a flat leaf-like structure, distal part conical and bent slightly inwards, with maximum width at almost mid-length of combined lengths of segments ; its bent outer margin bearing well-defined serrations, posterior to which is present a long spine marking position of fusion between Re_2 and Re_3 ; Re_{2-3} terminating in subequal blunt processes and with three setæ along inner margin.

Remarks.—In the nature of the posterior corners of T-V and the structure of male P-5 this species differs distinctly from the known species of the genus *Pseudodiaptomus*. However, it shows some affinities towards *P. ardjuna* from which it can again be separated by the following characters : (1) T-V produced into asymmetrical spines in *P. ardjuna* whereas in *P. jonesi* it is obtuse ; (2) differences noted in the proportionate lengths of female A-1 segments ; (3) female P-5 of these two species differ in the length : width ratio of Re_1. In male differences are found in the modification of the constituting parts of the P-5 such as the endopodal processes on both legs and the spinuous outgrowth on Re_1 and the terminal Re_{2-3} of left leg.

From the collections it would appear that this species prefers water ranging between 31·82 and 34·08‰ salinity.

One male specimen collected by Wellershaus[11] from Cochin Backwaters on 10-3-1966 from surface (No. Cop. 39 Kiel Zool. Museum) and briefly described by him as *P. ardjuna* distinctly belongs to *P. jonesi*.

The new species is named after Dr. S. Jones as a tribute to his untiring efforts towards the development of marine sciences of this region.

My grateful thanks are due to Dr. S. Jones, Director, for the encouraging guidance ; to Dr. E. G. Silas for critical suggestions and helps during the course of this work ; and to C.S.I.R. for the award of a Fellowship. Dr. T. E. Bowman, Smithsonian Institution, U.S.A. and Dr. S. Wellershaus, Institut für Meeresforschung, Germany, have helped me with necessary references.

---

1. Sewell, R. B. S., *Mem. Indian Mus.*, 1932, **10**, 233.
2. —, *Proc. Linn. Soc. London*, 1956, **166**, 168.
3. Brehm, V., *Mem. Inst. Sci. Madagascar*, 1951, **6** (2), 419.
4. —, *Ost. Zool. Z.*, 1953, **4**, 305, 313.
5. —, *Anz. Ost. Akad. Wiss.*, 1954, **163** (8), 603.
6. Nicholls, A. G., *Rec. S. Aust. Mus.*, 1944, **8**, 10.
7. Tanaka, O., *Spl. publ. Seto Mar. Biol. Lab.*, 1960, **10**, 47.
8. Ummerkutty, A. N. P., *J. mar. biol. Ass. India*, 1960, **2** (2), 179.
9. Desai, H. V. and Bal, D. V., *J. Bombay nat. Hist. Soc.*, 1961, **58** (3), 812.
10. Grindley, R., *Ann. S. African Mus.*, 1964, **46**, 381.
11. Wellershaus, *Veroff. Inst. Meeresforsch. Bremerh.*, 1969, **11** (2), 259.
12. Grice, G. D., *Crustaceana*, 1969, **16** (2), 125.

III CELL BIOLOGY CONFERENCE UNIVERSITY OF DELHI

A CONFERENCE of Cell Biologists in the country was held in the Department of Zoology under the auspices of the Centre of Advanced Study from December 29th to 31st, 1969. This was the third such Conference. It brought together scientists, interested in cell structure and function, working in a number of Universities and Research Institutes in the country. Over a hundred participants read 55 papers. Broadly speaking, the Conference dealt with Cell Biology under three heads. 1 Cell Structure, function and differentiation 2 Cytogenetics 3 Action of radiation and chemicals at the cellular level.

Several workers from the Biology Division of the Bhabha Atomic Research Centre presented results of their investigations on a wide variety of subjects. P R Mahadevan dealt with cell wall bound enzymes in *Neurospora* and problems of RNA in the organism. A comparative microspectrophotometric study of pigment composition in *Anabaena* was presented by Joseph Thomas. K Sundaram and his colleagues dealt with the effects of antilymphocyte serum on lymph node cells. S Narayanaswamy presented a paper on tissue differentiation in certain plant cells. A paper on isolation of bacterial membrane was presented by R B Singh. The biological effects of high background radioactivity, especially on plant populations growing in the high radiation areas of Kerala and Madras States, was presented by G G Nayar.

From the Cancer Research Institute, Bombay, B M Braganca discussed the results of her group on the changes produced by a cytotoxic protein from Cobra venom on Yoshida Sarcoma Cell membrane. The Indian Agricultural Research Institute was also well represented. R N Raut presented a paper on differential strength of nucleolar chromosomes in cellular RNA synthesis. Two papers on human chromosomes were presented by R A Pai and K Kant. B N Chowdaiah from the Zoology Department Bangalore University, presented the salivary gland map of *Anopheles barbirostris*. Other aspects relating to the chromosomes of higher organisms, concerned with the dosage compensation phenomenon in *Drosophila* and DNA replication in duplicate type of sex chromosomes of an insectivore, *Suncus*, were presented by Lakhotia from the Zoology Department, Calcutta University and V. K. Sharma from the Zoology Department, University of Delhi, respectively. Aspects of sexual dimorphism in the interphase nuclei in some reptiles were discussed by T. Sharma from the Zoology Department of Banaras Hindu University. Besides these, several papers dealing with effects of chemicals on chromosomal organisation and cellular metabolism were read at the Conference. R Vimla Nair from the Biochemistry Department of Calcutta University dealt with the effects of actinomycin C on mitosis and DNA synthesis in a mold, *Physarum polycephalum*. In higher organisms, specially on *Vicia faba*, two papers concerning the effects of an alkylating agent, Mitomycin-C and an alkloid, Vincaleukoblastine (VLB) were presented by V. C. Shah and Sharda respectively, both from the Zoology Department, University of Delhi. R. P. Sharma from the Indian Agricultural Research Institute discussed the probable mechanism of induced meiotic crossing over in *Drosophila melanogaster*. S. V. Goswami of the Delhi University, Zoology Department, presented a paper on the action of steroid and protein hormones on *in vitro* maturation of oocyte of the cat fish, *Heteropnuestes fossilis*. The ultrastructural organisation of the macronuclear replication band in a ciliate, *Stylonuchia notiphora* was presented by C M S Dass, Zoology Department, Delhi University. G Bhaumik, of the Biophysics Division of Saha Institute of Nuclear Physics, discussed the variation in the X-ray sensitivity on the replicative states of DNA in bacteria.

An important lesson which one gained from the Conference was that modern work in Cell Biology needed the collaboration of persons working in different fields and that people trained in classical biology were clearly at a disadvantage. This was beautifully illustrated by the fact, the most outstanding contributions came from the Bhabha Atomic Research Centre where, in the Biology Division, Physicists, Chemists, and Biologists work together on problems of cell structure and function, bringing to bear on them the advantages of their training in their respective fields. It is an indisputable fact that today it is the physicists and chemists rather than classical biologists that are making important break-throughs in Biological Sciences. In contrast with, BARC, the disadvantage which the Biology Departments of the Universities suffered from was clear. For, in the Universities, we still have old concepts of classical Botany and Zoology with little possibility of interaction with physics and chemistry. Can one imagine, in the present state of our Universities, physicists and chemists being appointed in Biology departments or *vice versa*? As long as we continue to cling to ancient ideals, our Biological Research must remain ancient.

S. R. V. RAO

in ratio of L:W being 2·5 : 1 (*versus* 3·0 : 1 in *P. ardjuna*).

Male: Total length for 28 adults range 0·96–0·98 mm., with mean length 0·97 mm.; T-V posteriorly obtuse; five-segmented urosome with caudal rami showing proportionate lengths = 11 : 26 : 17 : 17 : 12 : 17%; U-I short, devoid of dorsal spikes; U-II to U-IV with rows of small triangular spikes as in female; U-V with serrated shield as in female; caudal rami symmetrical, its ratio of L:W = 2·5 : 1; geniculate right A-1 with 19 segments; four large spines one each on segments 10–13, that on segment 10 being longer and recurved at its tip with a small secondary spike; segments 14–16 enlarged each with a slender spine dorsally; serrated plate on segment 18 with minute villiform teeth; distal to hinge three segments present, but segmentation indistinct between terminal and penultimate segments. *Fifth legs*: Right P-5 with B_2 slightly longer than wide and with a row of minute spines along its outer mid margin; B_2 produced at proximal inner margin into a bifurcated process with antler-like arms of unequal length and construction; inner ramus still further branched into two processes, each distally tridentate; outer ramus is asymmetrically bifid at tip; Re_1 as long as wide and dentate along its oblique distal edge and produced into an outer, large broad spine extending upto the distal margin of Re_2 and tapering towards extremity; lateral spine of Re_1 asymmetrically bifid distally (at its 4/5th distal length); Re_2 with L:W ratio = 2 : 1, and provided with a long distal outer marginal spine 30% length of lateral spine of Re_1; a few small spinnules present between former and base of Re_3; Re_3 sickle-shaped, with two blunt outgrowths along inner margin towards base and two setæ placed equidistant along outer margin; left P-5 with B_2 longer than broad and with a set of small lateral spines on its outer margin; B_2 produced at inner distal margin into a digitiform curved process which reaches middle of Re_2; Re_1 with a stout spine at outer distal corner which exceeds 50% length of segment; Re_{2-3} fused, forming a flat leaf-like structure, distal part conical and bent slightly inwards, with maximum width at almost mid-length of combined lengths of segments; its bent outer margin bearing well-defined serrations, posterior to which is present a long spine marking position of fusion between Re_2 and Re_3; Re_{2-3} terminating in subequal blunt processes and with three setæ along inner margin.

Remarks.—In the nature of the posterior corners of T-V and the structure of male P-5 this species differs distinctly from the known species of the genus *Pseudodiaptomus*. However, it shows some affinities towards *P. ardjuna* from which it can again be separated by the following characters: (1) T-V produced into asymmetrical spines in *P. ardjuna* whereas in *P. jonesi* it is obtuse; (2) differences noted in the proportionate lengths of female A-1 segments; (3) female P-5 of these two species differ in the length : width ratio of Re_1. In male differences are found in the modifications of the constituting parts of the P-5 such as the endopodal processes on both legs and the spinuous outgrowth on Re_1 and the terminal Re_{2-3} of left leg.

From the collections it would appear that this species prefers water ranging between 31·82 and 34·08‰ salinity.

One male specimen collected by Wellershaus[11] from Cochin Backwaters on 10-3-1966 from surface (No. Cop. 39 Kiel Zool. Museum) and briefly described by him as *P. ardjuna* distinctly belongs to *P. jonesi*.

The new species is named after Dr. S. Jones as a tribute to his untiring efforts towards the development of marine sciences of this region.

My grateful thanks are due to Dr. S. Jones, Director, for the encouraging guidance; to Dr. E. G. Silas for critical suggestions and helps during the course of this work; and to C.S.I.R. for the award of a Fellowship. Dr. T. E. Bowman, Smithsonian Institution, U.S.A. and Dr. S. Wellershaus, Institut fur Meeresforschung, Germany, have helped me with necessary references.

---

1. Sewell, R. B. S., *Mem. Indian Mus.*, 1932, **10**, 233.
2. —, *Proc. Linn. Soc. London*, 1956, **166**, 168.
3. Brehm, V., *Mem. Inst. Sci. Madagascar*, 1951, **6** (2), 419.
4. —, *Ost. Zool. Z.*, 1953, **4**, 305, 313.
5. —, *Anz. Ost. Akad. Wiss.*, 1954, **163** (8), 603.
6. Nicholls, A. G., *Rec. S. Aust. Mus.*, 1944, **8**, 10.
7. Tanaka, O., *Spl. publ. Seto Mar. Biol. Lab.*, 1960, **10**, 47.
8. Ummerkutty, A. N. P., *J. mar. biol. Ass. India*, 1960, **2** (2), 179.
9. Desai, H. V. and Bal, D. V., *J. Bombay nat. Hist. Soc.*, 1961, **58** (3), 812.
10. Grindley, R., *Ann. S. African Mus.*, 1964, **46**, 381.
11. Wellershaus, *Veroff. Inst. Meeresforsch. Bremerh.*, 1969, **11** (2), 259.
12. Grice, G. D., *Crustaceana*, 1969, **16** (2), 125.

III CELL BIOLOGY CONFERENCE—UNIVERSITY OF DELHI

A CONFERENCE of Cell Biologists in the country was held in the Department of Zoology under the auspices of the Centre of Advanced Study from December 29th to 31st, 1969. This was the third such Conference. It brought together scientists, interested in cell structure and function, working in a number of Universities and Research Institutes in the country. Over a hundred participants read 55 papers. Broadly speaking, the Conference dealt with Cell Biology under three heads: 1. Cell Structure, function and differentiation. 2. Cytogenetics. 3. Action of radiation and chemicals at the cellular level.

Several workers from the Biology Division of the Bhabha Atomic Research Centre presented results of their investigations on a wide variety of subjects. P. R. Mahadevan dealt with cell wall bound enzymes in *Neurospora* and problems of RNA in the organism. A comparative microspectrophotometric study of pigment composition in *Anabœna* was presented by Joseph Thomas. K. Sundaram and his colleagues dealt with the effects of antilymphocyte serum on lymph node cells. S. Narayanaswami presented a paper on tissue differentiation in certain plant cells. A paper on iodination of bacterial membrane was presented by B. B. Singh. The biological effects of high background radioactivity, especially on plant populations growing in the high radiation areas of Kerala and Madras States, was presented by G. G. Nayar.

From the Cancer Research Institute, Bombay, B. M. Braganca discussed the results of her group on the changes produced by a cytotoxic protein from Cobra venom on Yoshida Sarcoma Cell membrane. The Indian Agricultural Research Institute was also well represented. R. N. Raut presented a paper on differential strength of nucleolar chromosomes in cellular RNA synthesis. Two papers on human chromosomes were presented by R. A. Pai and K. Kant. B. N. Chowdaiah from the Zoology Department, Bangalore University, presented the salivary gland map of *Anopheles barbirostris*. Other aspects relating to the chromosomes of higher organisms, concerned with the dosage compensation phenomenon in *Drosophila* and DNA replication in duplicate type of sex chromosomes of an insectivore, *Suncus*, were presented by Lakhotia from the Zoology Department, Calcutta University and V. K. Sharma from the Zoology Department, University of Delhi, respectively. Aspects of sexual dimorphism in the interphase nuclei in some reptiles were discussed by T. Sharma from the Zoology Department of Banaras Hindu University. Besides these, several papers dealing with effects of chemicals on chromosomal organisation and cellular metabolism were read at the Conference. R Vimla Nair from the Biochemistry Department of Calcutta University dealt with the effects of actinomycin-C on mitosis and DNA synthesis in a mold, *Physarum polycephalum*. In higher organisms, specially on *Vicia faba*, two papers concerning the effects of an alkylating agent, Mitomycin-C and an alkloid, Vincaleukoblastine (VLB) were presented by V. C. Shah and Sharda respectively, both from the Zoology Department, University of Delhi. R. P. Sharma from the Indian Agricultural Research Institute discussed the probable mechanism of induced meiotic crossing over in *Drosophila melanogaster*. S. V. Goswami of the Delhi University, Zoology Department, presented a paper on the action of steroid and protein hormones on *in vitro* maturation of oocytes of the cat-fish, *Heteropnuestes fossilis*. The ultrastructural organisation of the macronuclear replication band in a ciliate, *Stylonychia notiphora* was presented by C. M. S. Dass, Zoology Department, Delhi University. G. Bhaumik, of the Biophysics Division of Saha Institute of Nuclear Physics, discussed the variation in the X-ray sensitivity on the replicative states of DNA in bacteria.

An important lesson which one gained from the Conference was that modern work in Cell Biology needed the collaboration of persons working in different fields and that people trained in classical biology were clearly at a disadvantage. This was beautifully illustrated by the fact, the most outstanding contributions came from the Bhabha Atomic Research Centre where, in the Biology Division, Physicists, Chemists, and Biologists work together on problems of cell structure and function, bringing to bear on them the advantages of their training in their respective fields. It is an indisputable fact that today it is the physicists and chemists rather than classical biologists that are making important break-throughs in Biological Sciences. In contrast with, BARC, the disadvantage which the Biology Departments of the Universities suffered from was clear. For, in the Universities, we still have old concepts of classical Botany and Zoology with little possibility of interaction with physics and chemistry. Can one imagine, in the present state of our Universities, physicists and chemists being appointed in Biology departments or *vice versa*? As long as we continue to cling to ancient ideals, our Biological Research must remain ancient.

S. R. V. Rao

LETTERS TO THE EDITOR

PARTICLES IN EINSTEIN UNIVERSE

In recent years Riemannian manifolds V_4 with the respective groups of motion G_n, $0 \leqslant n \leqslant 10$, have been extensively used in particle Physics.[1-5] One aspect of this study is to investigate the eigen-value problem of the Laplace-Beltrami operator as generalized Klein-Gordon equation with Riemannian background. In this note we report our investigation of this problem with the use of static spherically symmetric Einstein manifold.

Starting with the line element pertaining to Einstein universe[8]

$$ds^2 = dt^2 - \left(1 - \frac{r^2}{K^2}\right)^{-1} dr^2 - r^2 (d\theta^2 + \sin^2\theta d\phi^2), \tag{1}$$

we investigate the eigen-value problem of the following equation :[5-7]

$$(\sqrt{-g}\, g^{\mu\nu} \psi,_{\mu}),_{\nu} - M^2 \sqrt{-g}\, \psi = 0. \tag{2}$$

Here $\psi = \psi(x^{\mu})$ is a scalar function, and in the spherically symmetric case it will depend on r, *i.e.*, $\psi = (r)$. We wish to emphasize that (1) is a solution of the Einstein equations[9]

$$R_{\mu\nu} = \chi g_{\mu\nu}, \tag{3}$$

having the energy momentum tensor $T_{\mu\nu} \propto g_{\mu\nu}$, so that (3) describes a space of constant curvature with the Cosmological constant Λ being equal to zero. It is known[8,9] that the Riemannian manifolds V_4 described by (1) may be considered as $S^3 \times R$ which can be embedded isometrically in R^5 as a hyperspherical cylinder, S^3 being the hypersphere, $Z_1^2 + Z_2^2 + Z_3^2 + Z_4^2 = K^2$, in R^4 (Z_1, Z_2, Z_3, Z_4). The groups of motion of this V_4 are therefore $O_4 \times R$. With this interpretation we take K as the radius of the particle under consideration. Use of (1) in (2) gives following equation :

$$\frac{d}{dr}\left\{r^2 \left(1 - \frac{r^2}{K^2}\right)^{\frac{1}{2}} \frac{d\psi}{dr}\right\} + M^2 r^2 \left(1 - \frac{r^2}{K^2}\right)^{-\frac{1}{2}} \psi = 0. \tag{4}$$

If we put $x = \left(1 - \frac{r^2}{K^2}\right)^{\frac{1}{2}}$, (4) becomes

$$(1 - x^2) \frac{d^2\psi}{dx^2} - 3x \frac{d\psi}{dx} + M^2 K^2 \psi = 0. \tag{5}$$

Equation (5) is a differential equation of the following type :[9]

$$(1 - x^2) \frac{d^2\psi}{dx^2} - (2\mu - 1) \frac{d\psi}{dx} + \nu(\nu + 2\mu)\psi = 0, \tag{6}$$

with $\mu = 2$,

and

$$\nu = -2 + \sqrt{4 + M^2 K^2}. \tag{7}$$

For solutions of interest ν has to be an integer. This is possible if we take

$$M^2 K^2 = n(n + 4), \tag{8}$$

where n is an integer. The solutions of ψ are then the associated Legendre's function $C_{\nu}^{\mu}(x)$ as the coefficients of h^{ν} in the expansion of $(1 - 2xh + h^2)^{\mu}$. First few of them are given below :

$$C_0(x) = 1, \quad C_1(x) = 4x,$$
$$C_2(x) = (12x^2 - 2), \quad C_3(x) = (32x^3 - 12x), \tag{9}$$

Equation (8) is an interesting relation between M and K. We know[11] that $M = mc/\hbar$, in the Klein-Gordon equation. With the use of natural units where $C = 1$ and $\hbar = 1$, the mass $(M = m)$ has the natural dimensionality as[11] L^{-1}. It is therefore clear that (8) is a correct relationship between mass and the radius of the particle in natural units.

If we take $n = 0$, (8) gives a particle of zero mass which cannot be very clearly identified. For $n = 1$, and with the use of proton mass $M_p = 938$ MeV, it gives $R_p = 0{\cdot}47$ *fm* which is in close agreement with the recently determined radius[12] $R_p = 0{\cdot}35$ *fm* of the interior of the proton sphere. For $n > 1$ the interpretation is not clear. It may possibly be given if we consider Baryon and Meson states as the various resonance states of one particle only. The Quarks[13] that have been taken as the basic constituents of hadrons, have not been discovered so far, and therefore we have no knowledge of the same in terms of M and K.

Department of Physics, N. K. Sharma.
University of Rajasthan,
Jaipur (India), October 13, 1969.

---

1. Komar, A., *Phys. Rev. Letters*, **1964**, **13**, 220.
2. Raczka, R., *Trieste Preprint*, 1965, Ic/56/36.
3. Roman, P. and Aghassi, J. J., *Phys. Letters*, 1965, **14**, 68; *Nuovo Cimento*. 1965, **36**, 1062; 1965, **37**, 354; 1965, **38**, 1092; 1966, **42 A**, 193.
4. Flato, M., Sternheimer, D., Sternheimer, J., Vigier, J. P. and Wataghin, G., *Nuovo Cimento*, 1966, **42 A**, 431.
5. Prasad, R., *Ibid.*, 1965, **38**, 1921 : 1966 ; **44 A**. 299; 1967, **52 A**, 972.
6. Burcev, P., *Ibid.*, 1968, **59 A**, 795.

7. Schrödinger. E., *Expanding Universe*, Cambridge, London, 1957, Ch. 4.
8. Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, Oxford, London, 1934, p. 337.
9. Petrov, A. Z., *Einstein spaces*, (English translation by R. F. Kelleher), Pergamon Press, London, 1969, p. 76.
10. Ince, E. L., *Ordinary Differential Equations*, Dozer, 1956, p. 183.
11. Sakurai, J. J., *Advanced Quantum Mechanics*, Addison-Wesley, California, 1967, p. 179.
12. Schopper, H., *Scient. Rept. CERN*, 1967, No. 3.
13. Kokkedee, J. J., *The Quark Model*, *Benjamin*, New York, 1969.

ORDER OF REACTION FOR THE THERMAL DEGRADATION OF BUTYL RUBBER IN CHLOROBENZENE

It has been observed[1] that the thermal degradation of butyl rubber in solution proceeds through a random chain-scission mechanism. Simha and Wall[2] have shown theoretically that a first order law is incompatible with such a process. It was reported earlier[3] that the thermal degradation of butyl rubber dissolved in p-xylene, tetralin, decalin and bromobenzene is independent with respect to the polymer concentration in solution. In the present investigation, the degradation of butyl rubber has been carried out in chlorobenzene in the concentration range 0·5-2·0% (wt./vol.) with a view to determining the order of reaction.

The butyl rubber sample (a copolymer of isobutylene and isoprene) was supplied through the courtesy of Dr. A. B. Biswas, Indian Institute of Technology, Bombay, and was used as such without further purification. Chlorobenzene (MB) was purified by standard techniques. Degradation was carried out at 140° C. for different intervals of time as described elsewhere.[3,4] Studies were carried out at four different polymer concentrations. The process of thermal degradation was followed viscometrically. Measurements were made in a modified Cannon-Ubbelhode dilution viscometer suspended in a water thermostat at 37° C. The values of intrinsic viscosity were evaluated from the experimental data using the triple plot method.[5]

Figure 1 shows the plots of $[\eta]_t/[\eta]_0$ *versus* time of degradation, where $[\eta]_0$ is the intrinsic viscosity of the undegraded sample and $[\eta]_t$ is the intrinsic viscosity of the sample degraded for time *t*. The data clearly indicate that the extent of degradation is independent of polymer concentration in the range investigated. Thus, the thermal degradation of butyl rubber in chlorobenzene follows a zero order law with respect to the polymer concentration in agreement with the theoretical results.[2]

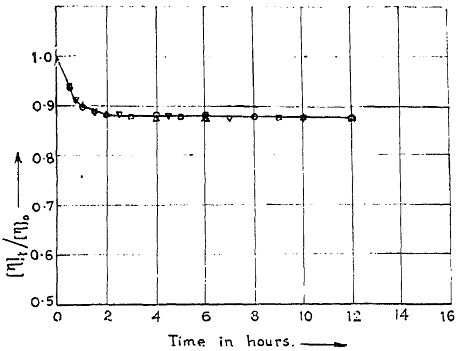


FIG. 1. Butyl rubber + chlorobenzene system; Concentration, %: △—2·00; ⊙—1·00; ▣—0·75; ▽—0·50.

It can be further concluded that the process of thermal degradation in solution is not a diffusion controlled process as the dilution has no effect on the magnitude of degradation.

Dept. of Chemistry, Punjabi University, Patiala, *October* 3, 1969. MANMOHAN SINGH.

---

1. Singh, M. M., *Ph.D. Thesis*, Kurukshetra University, Kurukshetra, 1968.
2. Simha, R. and Wall, L. A., *J. Phys. Chem.*, 1952, **56**, 707.
3. Singh, M. M. and Bhatnagar, H. L., *Indian J. Chem.*, 1968, **6**, 218.
4. Lal, K., Singh, M. M. and Bhatnagar, H. L., *Ibid.*, 1967, **5**, 412.
5. Singh, M. M. and Bhatnagar, H. L., *Ibid.*, 1967, **5**, 548.

REDUCTIMETRIC DETERMINATION OF SELENITE

The reduction of Se (IV) to elemental selenium by Fe(II) was found to be very slow in sulphuric acid medium. However, when sufficient concentration of chloride was present in the medium, the reduction occurred readily. This observation led to the development of the following procedure for accurate determination of selenites: To exactly 5–10 ml. of solution containing about 0·25 mM of Se(IV), 20–25 ml. of 18 M sulphuric acid are added. After cooling to 25°, 2–5 ml. of 10 M hydrochloric acid are added followed by the addition of exactly 20 ml. of 0·1 N. ferrous sulphate solution. After 5 minutes, the precipitated selenium is filtered and the filtrate diluted to about 250 ml. The excess of Fe(II) in the filtrate is determined by titration with standard vanadate solution. [Each ml. of

0·1 N vanadate is equivalent to 0·025 mM. of Se(IV)]. The results obtained were accurate and compared well with the values obtained following other redox methods.[1-8] Interference was noted in the presence of Se(VI) but Te(IV) and Te(VI) did not react with Fe(II) under the above conditions. In the absence of Te(IV) in the selenite samples, standard potassium dichromate could also be used for titration of excess Fe(II) in the estimation.

The author wishes to express his grateful thanks to Dr. G. Aravamudan for his interest.

Department of Chemistry, V. R. S. RAO.
Indian Inst. of Technology,
Madras-36, *October* 15, 1969.

---

1. Adams, D. F. and Gilbertson, L. S., *Ind. Eng. Chem.*, Anal. Ed., 1942, **14**, 926.
2. Tomicek, O. and Fillipovic, P., *Collection Czech Chem. Communs.*, 1938, **10**, 340, 415.
3. Van der Meulen, J. H., *Chem. Weekblad*, 1934, **31**, 333.
4. Stamm, H. and Goehring, M., *Z. Anal. Chem.*, 1940, **120**, 230.
5. Kolthoff, I. M., Belcher, R., Strenger, V. A. and Matsuyama, G., *Volumetric Analysis*, Vol. III, Interscience Publishers, Inc., New York, 1957, 328.
6. Coleman, W. C. and McCrosky, C. R., *Ind. Eng. Chem.* Anal. Ed., 1937, **9**, 431.
7. Suseela, B., *Z. Anal. Chem.* 1955, **147**, 13.
8. Coleman, W. C. and McCrosky, C. R., *J. Am. Chem. Soc.*, 1937, **59**, 1458.

THE SYSTEM LITHIUM SULPHATE-THIOUREA-WATER AT 30° C.

As part of our studies on establishing the differences between thiourea and urea as adduct forming species and ligands towards metal salts, a phase equilibrium study of the system lithium sulphate-thiourea-water was made at 30° C. The experimental details and results are described below.

Mixtures comprised of the three components were prepared by various methods as follows: (1) By mixing powdered lithium sulphate (both in anhydrous and monodydrate forms) and aqueous solutions of thiourea. (2) By mixing powdered thiourea and solutions of lithium sulphate, and (3) By controlled evaporation at 30° C. of solutions containing different molar proportions of lithium sulphate and thiourea. The mixtures were agitated at 30 ± 0·1° C. in a thermostat and after 8-10 hours, the saturated solution and the corresponding wet residue were separated and analyzed for the components. The lithium sulphate content was found out from the gravimetric determination of sulphate, and thiourea was determined by the hypoiodite method.[1]

TABLE I

The system lithium sulphate-thiourea-water at 30° C.

Amount contained in 100 g. of saturated solution		Amount contained in 100 g. of wet residue		Composition of solid phase
Li_2SO_4 g.	Thiourea g.	Li_2SO_4 g.	Thiourea g,	
..	17·8	..	..	Thiourea
1·22	17·3	0·39	73·5	,,
3·05	16·5	0·92	75·0	,,
4·10	15·9	1·21	75·2	,,
6·01	15·2	1·68	76·3	,,
8·32	14·0	2·58	73·4	,,
10·3	13·5	2·77	76·2	,,
13·0	12·6	3·91	73·8	,,
15·7	11·2	4·56	74·2	,,
18·7	9·98	5·25	74·8	,,
20·1	9·67	6·24	72·0	,,
20·2	9·56	21·6	50·2	Thiourea + $Li_2SO_4.H_2O$
26·7	..	..	..	$Li_2SO_4.H_2O$
23·9	3·13	67·3	0·69	,,
22·8	4·98	66·0	1·57	,,
21·6	7·34	67·5	2·09	,,
20·2	9·42	66·2	2·90	,,

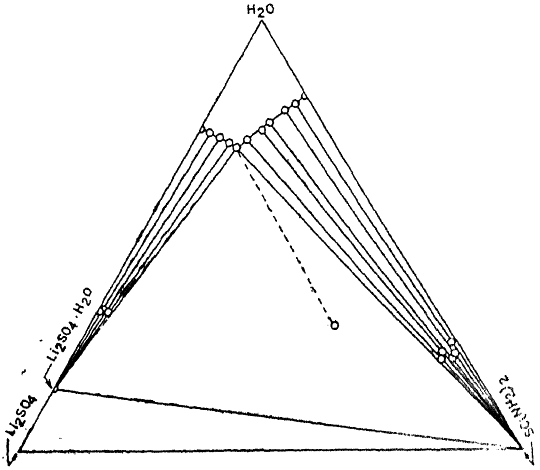


FIG. 1. The system Li_2SO_4–$NH_2.CS.NH_2$–H_2O at 30° C.

The phase equilibrium data obtained at 30° C. is given in Table I and the equilibrium diagram is plotted in Fig. 1. It could be seen that lithium sulphate monohydrate and thiourea are the only stable solid phases at 30° C. Microscopic and chemical examinations of crystals separating from evaporation of solutions containing thiourea and lithium sulphate in the temperature range 0-45° C. did not reveal formation of any new compound. Attempted solid-solid interactions between anhydrous lithium sulphate and thiourea in the temperature range as the C^ also did not yield any adduct. Thus it could be concluded that there is no interaction between thiourea and lithium sulphate. In contrast to this, urea and lithium sulphate are known to form the compound, $Li_2SO_4 \cdot 3NH_2CONH_2$ as reported by Sulaimankulov and Naumova.

Dept. of Chemistry, M. RAMAKRISHNA CHETTY.
Indian Inst. of Tech., G. ARAVAMUDAN.
Madras-36, October 18, 1969.

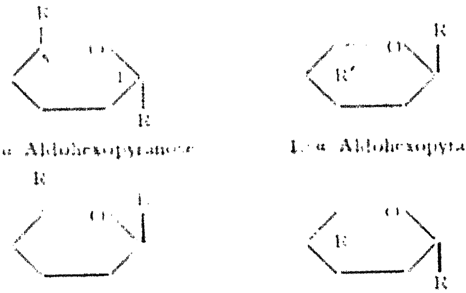
---

1. Kolthoff, I. M., Belcher, R., Stenger, V. A. and Matsuyama, G., *Volumetric Analysis*, Interscience, N.Y., 1957, p. 291.
2. Sulaimankulov, K. and Naumova, G. A., *Russ. J. Inorg. Chem.*, 1963, 8, 1158.

STEREO NUMBERS IN SUGAR CHEMISTRY

Part II.* Aldohexopyranoses

In an earlier paper,[1] a convenient method of remembering the stereochemistry of the sixteen aldohexoses was described for which the stereo numbers formed the basis. It is well known in sugar chemistry that many of the properties of the aldoses like mutarotation, formation of isomeric methyl glycosides, etc., are explained only by the cyclic hemi-acetal structure of the sugars. One of the possible cyclic structures is the six membered pyranose form. According to the Haworth representation of aldohexopyranoses, any hexose sugar belonging to the D-series should have the CH_2OH of the fifth carbon atom projecting above the plane of the ring and in the case of the L-sugars, this group projects below (see Fig. 1).



D-α-Aldohexopyranose L-α-Aldohexopyranose

D-β-Aldohexopyranose L-β-Aldohexopyranose

R = OH; R' = CH_2OH

Fig. 1

While the open chain aldehydo form of an aldohexose contains four asymmetric carbon atoms, a cyclic aldohexopyranose has five asymmetric carbon atoms and hence there are 32 (i.e., 2^5) optically active stereoisomeric substances possible for the aldohexopyranose. Sixteen of these belong to the D-series and the others to the L-series. For each of the aldohexose sugars like glucose there are two anomers designated as α- and β-sugars. In the case of sugars of the D-series, the anomeric hydroxyl group of C-1 projects below in α-sugars and it is above in the case of β-sugars. In the L-series, this hydroxyl group projects above in α-sugars and below in β-sugars (Fig. 1).

In the present paper, the idea of stereo numbers is applied to the aldohexopyranoses of both the D- and the L-series and the results are reported. For the binary system of representation, the hydroxyl groups of the asymmetric carbon atoms, projecting to the right in the Fischer projection formula, were given the number 1 and those to the left had the number 0 in the earlier paper.[1] In the Haworth representation, the hydroxyl groups of the carbon atoms 1 to 4 are directed either below or above and the CH_2OH of C-5 is also oriented either above or below the plane of the six membered ring. For the purpose of determining the binary code number of each of the thirty-two stereoisomeric aldohexopyranoses, those groups which project below the plane of the ring are given the number 1 and those above have the number 0. Based on this convention, the binary code numbers of the sixteen D-aldohexopyranoses and the sixteen members of the L-series as well as the respective decimal equivalents of the binary code numbers are given in Table I. The first digit at the extreme right is allotted to the group at C-1, the next at the left to the group at C-2 and so on.

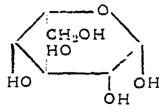
A knowledge of the values of the stereo numbers given in Table I can help us to write the stereochemical Haworth projection formula of any aldohexopyranose. This is illustrated below for L-β-idopyranose as an example. The stereo number of D-α-allopyranose is 15 and that of the D-β-isomer is 14. From Table I it is obvious that the stereo numbers of all β-sugars of the D-series are even numbers and they decrease from 14, which is the stereo number of D-β-allopyranose, to zero which is the stereo number of D-β-talopyranose. When we go from D-β-allopyranose to D-β-idopyranose we are going from the first sugar to the sixth according to the mnemonic.[4] Therefore, the stereo number of D-β-idopyranose is equal to 4 and hence the stereo number of the enan-

TABLE I

Binary code numbers and their decimal equivalents of aldohexopyranoses

Name of sugar	Binary code number	Decimal equivalent of the binary code number (stereo number)	Name of sugar	Binary code number	Decimal equivalent of the binary code number (stereo number)
D-α-Allopyranose	01111	15	L-α-Allopyranose	10000	16
D-β-Allopyranose	01110	14	L-β-Allopyranose	10001	17
D-α-Altropyranose	01101	13	L-α-Altropyranose	10010	18
D-β-Altropyranose	01100	12	L-β-Altropyranose	10011	19
D-α-Glucopyranose	01011	11	L-α-Glucopyranose	10100	20
D-β-Glucopyranose	01010	10	L-β-Glucopyranose	10101	21
D-α-Mannopyronose	01001	9	L-α-Mannopyranose	10110	22
D-β-Mannopyranose	01000	8	L-β-Mannopyranose	10111	23
D-α-Gulopyranose	00111	7	L-α-Gulopyranose	11000	24
D-β-Gulopyranose	00110	6	L-β-Gulopyranose	11001	25
D-α-Idopyranose	00101	5	L-α-Idopyranose	11010	26
D-β-Idopyranose	00100	4	L-β-Idopyranose	11011	27
D-α-Galactopyranose	00011	3	L-α-Galactopyranose	11100	28
D-β-Galactopyranose	00010	2	L-β-Galactopyranose	11101	29
D-α-Talopyranose	00001	1	L-α-Talopyranose	11110	30
D-β-Talopyranose	00000	0	L-β-Talopyranose	11111	31

tiomer, *viz.*, L-β-idopyranose is 27, because the sum of the stereo numbers of two enantiomers containing five asymmetric carbon atoms is 31 (*i.e.*, $2^5 - 1$). The decimal equivalent of 27 is 11011. Thus the Haworth stereochemical representation of L-β-idopyranose is as shown in formula (I).



(I)

Dept. of Chemistry, S. NEELAKANTAN.
Madurai University,
Madurai-2, *September* 26, 1969.

---

* The paper entitled "Application of stereo numbers in sugar chemistry", *Curr. Sci.*, 1969, **38**, 353, may be considered as Part I.

1. Neelakantan, S., *Curr. Sci.*, 1969, **38**, 353.
2. Feldman, A., *J. Org. Chem.*, 1959, **24**, 1556.
3. Haworth, W. N., *The Constitution of Sugars*, Arnold, London, 1929, p. 90.
4. Fieser, L. F. and Fieser, M., *Organic Chemistry*, Reinhold, New York, 3rd Edn., 1959, p. 359.

DIFFERENTIAL BLOOD-CELL COUNTS IN THREE SPECIES OF MAJOR CARPS

LITTLE information is available on the hæmatology of Indian fishes. Previous studies in this field mainly deal with the blood constituents such as packed cell volume, hæmoglobin content, erythrocyte and leucocyte counts and clotting time. No attempt has so far been made on the differential blood-cell counts of the fishes excepting in a recent publication[4] dealing with air-breathing species. It is well known that the composition of blood-cell changes under different ecological, pathological and physiological[2,3,7] conditions; but before determining the changes induced by these factors, it seems desirable to establish first the normal blood picture of some common fishes. The present communication attempts to report briefly the differential blood-cell counts of the three Indian major carps *Labeo rohita* (Ham.) (***Rohu***), *Cirrhina mrigala* (Ham.) (***Mrigal***), and *Catla catla* (Ham.) (***catla***).

Fishes which formed the basis of the present study were collected from the University Fish Farm, where they were raised from fingerling stage. Methods for obtaining the blood and for the preparation of slides for differential blood-cell counts were the same as reported earlier.[4] Thrombocytes, large and small lymphocytes, neutrophils and basophils were recorded in the circulating blood of the three species. Percentages for mature and immature erythrocytes were also determined after counting 100 erythrocytes from each fish.

Among leucocytes, higher percentages were found for the thrombocytes. Mean values for ***Rohu, Mrigal*** and ***Catla*** were 60·2%, 64·7% and 63·2% respectively (Table I). The values obtained here are approximately the same as those reported for some marine fishes[8] and are higher than those reported for the air-breathing fishes.[4]

Small lymphocyte counts showed a mean of 34·0% in ***Rohu***, 29·0% in ***Mrigal*** and 30·9% in ***Catla***. Earlier workers[5-6,8,10] have reported

TABLE I

Differential blood-cell counts in three species of major carps

Blood constituents	*Labeo rohita*		*Cirrhina mrigala*		*Catla catla*	
	Range	Mean	Range	Mean	Range	Mean
Erythrocytes (%) :						
Mature	..	97·0	..	97·5	..	96·5
Immature	..	3·0	..	2·5	..	3·5
Thrombocytes (%)	56·0–68·0	60·2	63·0–67·0	64·7	55·0–74·0	63·2
Non-Granulocytes (%) :						
Large lymphocytes	0·0– 2·0	0·5	0·0– 2·0	0·5	0·0– 3·0	0·6
Small lymphocytes	25·0–37·0	34·0	28·0–30·0	29·0	20·0–39·0	30·9
Granulocytes (%) :						
Neutrophils	1·0– 5·0	3·5	2·0– 6·0	4·0	2·0– 8·0	3·8
Eosinophils	0·0– 3·0	1·7	1·0– 3·0	1·6	0·0– 3·0	1·2
Basophils	0·0– 1·0	0·08	..	..	..	..

somewhat higher values of small lymphocytes, while the results reported for air-breathing fishes[4] were almost similar to those of the major carps.

Large lymphocytes were not found in all the specimens of the fish examined, although the average value for large lymphocytes in the three species did not differ markedly (Table I). These values were found to be substantially lower than those reported for the air-breathing fishes.[4]

Granulocytes contained the eosinophils and neutrophils which were quite common in all the three species, but the basophil was found only in ***Rohu***. The percentages for eosinophils were 1·7%, 1·6%, 1·2% and for neutrophils 3·5%, 4·0%, 3·8% in ***Rohu, Mrigal*** and ***Catla*** respectively. For eosinophils and neutrophils the percentages agree closely with those of the marine fishes,[8] and are significantly lower than those of the air-breathing species.[4]

The erythroblasts (immature erythrocytes) were 3·0% in ***Rohu***, 2·5% in ***Mrigal*** and 3·5% in ***Catla***. All these three species thus fall into group II and III made by Dawson.[1]

From the picture presented above, it is clear that, neglecting small differences, the composition of the blood-cells in the three species of carps is more or less identical (Table I), which indicates a similar physiological or ecological state of the fishes. Small fluctuations in the environmental factors such as temperature. pH, dissolved oxygen of water and the quality and quantity of food present in the environment, are supposed to have an immediate effect on the physiology of fishes which is in turn reflected from the blood-cells.[2,3,7,9] Since these factors seem to be common for the three species, and the three species are closely related systematically, no differences in differential blood-cell counts were noticed. Slight variations in the percentages of different blood-cells are probably specific to each species.

The authors are thankful to Dr. S. Z. Qasim, National Institute of Oceanography, Biological Centre, Ernakulam, for kindly going through the manuscript.

Department of Zoology, A. QAYYUM SIDDIQUI.
Aligarh Muslim Univ., SAGHIR H. KHAN.
Aligarh, *October* 10, 1969. S. M. NASEEM.

---

1. Dawson, A. B., *Biol. Bull.*, 1933, **64**, 33.
2. Eisler, R., *Chesapeake Sci.*, 1965, **6**, 119.
3. Engel, D. W. and Davis, E. M., *Copeia*, 1969, No. 3, p. 586.
4. Khan, S. H. and Siddiqui, A. Q., *Proc. Ind. Acad. Sci.*, 1969, **69**, 29.
5. Lieb, J. R., Slane, G. M. and Wilber, C. G., *Trans. Amer. Microsc. Soc.*, 1953, **72**, 37.
6. McKnight, I. M., *J. Fish. Res. Bd. Can.*, 1966, **23**, 45.
7. Smith, C. G., Lewis, W. M. and Kaplan, H. M. *Prog. Fish. Cult.*, 1952, **14**, 169.
8. Saunders, D. C., *Trans. Amer. Microsc. Soc.*, 1967, **85**, **427**.
9. Swarts, W., *Trans. Amer. Fish. Soc.*, 1969, **98**, 328.
10. Watson, L. J., Shechmeister, I. L. and Jackson, L. L., *Cytologia*, 1963, **28**, 118.

ON A LITTLE KNOWN MILIOLID FORAMINIFER FROM NORTH-EASTERN PART OF THE ARABIAN SEA

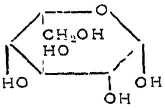
WHILE making a distribution analysis of the Foraminifera from snapper samples collected from the north-eastern part of the Arabian Sea during the cruises 2 and 4 on board I.N.S. 'Darshak' in January to February 1967 and 1969 the author came across a few very interesting specimens of a miliolid species, *Triloculina echinata* d'Orbigny. Certain

TABLE I

Binary code numbers and their decimal equivalents of aldohexopyranoses

Name of sugar	Binary code number	Decimal equivalent of the binary code number (stereo number)	Name of sugar	Binary code number	Decimal equivalent of the binary code number (stereo number)
D-α-Allopyranose ..	01111	15	L-α-Allopyranose ..	10000	16
D-β-Allopyranose ..	01110	14	L-β-Allopyranose ..	10001	17
D-α-Altropyranose ..	01101	13	L-α-Altropyranose ..	10010	18
D-β-Altropyranose ..	01100	12	L-β-Altropyranose ..	10011	19
D-α-Glucopyranose ..	01011	11	L-α-Glucopyranose ..	10100	20
D-β-Glucopyranose ..	01010	10	L-β-Glucopyranose ..	10101	21
D-α-Mannopyronose ..	01001	9	L-α-Mannopyranose ..	10110	22
D-β-Mannopyranose ..	01000	8	L-β-Mannopyranose ..	10111	23
D-α-Gulopyranose ..	00111	7	L-α-Gulopyranose ..	11000	24
D-β-Gulopyranose ..	00110	6	L-β-Gulopyranose ..	11001	25
D-α-Idopyranose ..	00101	5	L-α-Idopyranose ..	11010	26
D-β-Idopyranose ..	00100	4	L-β-Idopyranose ..	11011	27
D-α-Galactopyranose	00011	3	L-α-Galactopyranose	11100	28
D-β-Galactopyranose	00010	2	L-β-Galactopyranose	11101	29
D-α-Talopyranose ..	00001	1	L-α-Talopyranose ..	11110	30
D-β-Talopyranose ..	00000	0	L-β-Talopyranose ..	11111	31

tiomer, *viz.*, L-β-idopyranose is 27, because the sum of the stereo numbers of two enantiomers containing five asymmetric carbon atoms is 31 (*i.e.*, $2^5 - 1$). The decimal equivalent of 27 is 11011. Thus the Haworth stereochemical representation of L-β-idopyranose is as shown in formula (I).



(I)

Dept. of Chemistry, S. NEELAKANTAN.
Madurai University,
Madurai-2, *September* 26, 1969.

---

[*] The paper entitled "Application of stereo numbers in sugar chemistry", *Curr. Sci.*, 1969, **38**, 353, may be considered as Part I.

1. Neelakantan, S., *Curr. Sci.*, 1969, **38**, 353.
2. Feldman, A., *J. Org. Chem.*, 1959, **24**, 1556.
3. Haworth, W. N., *The Constitution of Sugars*, Arnold, London, 1929, p. 90.
4. Fieser, L. F. and Fieser, M., *Organic Chemistry*, Reinhold, New York, 3rd Edn., 1959, p. 359.

DIFFERENTIAL BLOOD-CELL COUNTS IN THREE SPECIES OF MAJOR CARPS

LITTLE information is available on the hæmatology of Indian fishes. Previous studies in this field mainly deal with the blood constituents such as packed cell volume, hæmoglobin content, erythrocyte and leucocyte counts and clotting time. No attempt has so far been made on the differential blood-cell counts of the fishes excepting in a recent publication[4] dealing with air-breathing species. It is well known that the composition of blood-cells changes under different ecological, pathological and physiological[2,3,7] conditions; but before determining the changes induced by these factors, it seems desirable to establish first the normal blood picture of some common fishes. The present communication attempts to report briefly the differential blood-cell counts of the three Indian major carps *Labeo rohita* (Ham.) (***Rohu***), *Cirrhina mrigala* (Ham.) (***Mrigal***), and *Catla catla* (Ham.) (***catla***).

Fishes which formed the basis of the present study were collected from the University Fish Farm, where they were raised from fingerling stage. Methods for obtaining the blood and for the preparation of slides for differential blood-cell counts were the same as reported earlier.[4] Thrombocytes, large and small lymphocytes, neutrophils and basophils were recorded in the circulating blood of the three species. Percentages for mature and immature erythrocytes were also determined after counting 100 erythrocytes from each fish.

Among leucocytes, higher percentages were found for the thrombocytes. Mean values for ***Rohu, Mrigal*** and ***Catla*** were 60·2%, 64·7% and 63·2% respectively (Table I). The values obtained here are approximately the same as those reported for some marine fishes[8] and are higher than those reported for the air-breathing fishes.[4]

Small lymphocyte counts showed a mean of 34·0% in ***Rohu,*** 29·0% in ***Mrigal*** and 30·9% in ***Catla.*** Earler workers[5-6,8,10] have reported

TABLE I

Differential blood-cell counts in three species of major carps

Blood constituents	Species					
	Labeo rohita		*Cirrhina mrigala*		*Catla catla*	
	Range	Mean	Range	Mean	Range	Mean
Erythrocytes (%) :						
Mature	..	97·0	..	97·5	..	96·5
Immature	..	3·0	..	2·5	..	3·5
Thrombocytes (%)	56·0–68·0	60·2	63·0–67·0	64·7	55·0–74·0	63·2
Non-Granulocytes (%) :						
Large lymphocytes	0·0– 2·0	0·5	0·0– 2·0	0·5	0·0– 3·0	0·6
Small lymphocytes	25·0–37·0	34·0	28·0–30·0	29·0	20·0–39·0	30·9
Granulocytes (%) :						
Neutrophils	1·0– 5·0	3·5	2·0– 6·0	4·0	2·0– 8·0	3·8
Eosinophils	0·0– 3·0	1·7	1·0– 3·0	1·6	0·0– 3·0	1·2
Basophils	0·0– 1·0	0·08	..	..	..	..

somewhat higher values of small lymphocytes, while the results reported for air-breathing fishes[4] were almost similar to those of the major carps.

Large lymphocytes were not found in all the specimens of the fish examined, although the average value for large lymphocytes in the three species did not differ markedly (Table I). These values were found to be substantially lower than those reported for the air-breathing fishes.[4]

Granulocytes contained the eosinophils and neutrophils which were quite common in all the three species, but the basophil was found only in ***Rohu***. The percentages for eosinophils were 1·7%, 1·6%, 1·2% and for neutrophils 3·5%, 4·0%, 3·8% in ***Rohu***, ***Mrigal*** and ***Catla*** respectively. For eosinophils and neutrophils the percentages agree closely with those of the marine fishes,[8] and are significantly lower than those of the air-breathing species.[4]

The erythroblasts (immature erythrocytes) were 3·0% in ***Rohu***, 2·5% in ***Mrigal*** and 3·5% in ***Catla***. All these three species thus fall into group II and III made by Dawson.[1]

From the picture presented above, it is clear that, neglecting small differences, the composition of the blood-cells in the three species of carps is more or less identical (Table I), which indicates a similar physiological or ecological state of the fishes. Small fluctuations in the environmental factors such as temperature. pH, dissolved oxygen of water and the quality and quantity of food present in the environment, are supposed to have an immediate effect on the physiology of fishes which is in turn reflected from the blood-cells.[2,3,7,9] Since these factors seem to be common for the three species, and the three species are closely related systematically, no differences in differential blood-cell counts were noticed. Slight variations in the percentages of different blood-cells are probably specific to each species.

The authors are thankful to Dr. S. Z. Qasim, National Institute of Oceanography, Biological Centre, Ernakulam, for kindly going through the manuscript.

Department of Zoology, A. QAYYUM SIDDIQUI.
Aligarh Muslim Univ., SAGHIR H. KHAN.
Aligarh, *October* 10, 1969. S. M. NASEEM.

---

1. Dawson, A. B., *Biol. Bull.*, 1933, **64**, 33.
2. Eisler, R., *Chesapeake Sci.*, 1965, **6**, 119.
3. Engel, D. W. and Davis, E. M., *Copeia*, 1969, No. 3, p. 586.
4. Khan, S. H. and Siddiqui, A. Q., *Proc. Ind. Acad. Sci.*, 1969, **69**, 29.
5. Lieb, J. R., Slane, G. M. and Wilber, C. G., *Trans. Amer. Microsc. Soc.*, 1953, **72**, 37.
6. McKnight, I. M., *J. Fish. Res. Bd. Can.*, 1966, **23**, 45.
7. Smith, C. G., Lewis, W. M. and Kaplan, H. M. *Prog. Fish. Cult.*, 1952, **14**, 169.
8. Saunders, D. C., *Trans. Amer. Microsc. Soc.*, 1967, **85**, 427.
9. Swarts, W., *Trans. Amer. Fish. Soc.*, 1969, **98**, 328.
10. Watson, L. J., Shechmeister, I. L. and Jackson, L. L., *Cytologia*, 1963, **28**, 118.

ON A LITTLE KNOWN MILIOLID FORAMINIFER FROM NORTH-EASTERN PART OF THE ARABIAN SEA

WHILE making a distribution analysis of the Foraminifera from snapper samples collected from the north-eastern part of the Arabian Sea during the cruises 2 and 4 on board I.N.S. 'Darshak' in January to February 1967 and 1969 the author came across a few very interesting specimens of a miliolid species, *Triloculina echinata* d'Orbigny. Certain

TABLE I

Station No.	Geographic position		Depth (m)	Temperature °C. (surface)	Nature of sediment	Occurrence
	Latitude	Longitude				
21	19° 7′ N	72° 2′ E	64	24·72	Sandy	Rare
23	20° 16′·7 N	70° 34′·5 E	77	23·88	Muddy sand	,,
40	18° 34′·5 N	72° 22′·0 E	62	26·38	Sandy	,,

observations made on this species are given below.

ORDER : FORAMINIFERA
FAMILY : MILIOLIDAE
GENUS : Triloculina d'Orbigny, 1826.

Triloculina echinata d'Orbigny (Fig. 1, *a–c*.)

Shape.—Test as long as broad, subspherical in outline.

Chambers.—Three on one side and two on the other, each being half a coil in length and closely placed together. Periphery of the test rounded ; final chamber longer than other two with little or no apertural neck ; surface ornamented with spines arranged in longitudinal rows ; aperture round with a simple bifid tooth.

Dimensions of the test : 0·525 mm. in length, 0·450 mm. in breadth and 0·09 mm. in diameter of aperture.

Colour.—White with a brownish tinge.

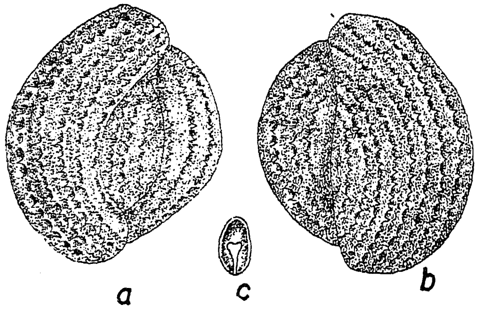


FIG. 1. *Triloculina echinata* d'Orbigny *a*, Dorsal view ; *b*, Ventral view ; *c*, Apertural view.

Distribution.—In the area under study this species was rare at all stations as given in Table I.

Remarks and Previous Records.—The miliolid species described here resembles that of d'Orbigny (1826)[1] from St. Helena in South Atlantic, which he named *Triloculina echinata*. d'Orbigny had given only a figure of his species with no description. Further no prototype material from St. Helena is available at present. Subsequently, Fornasini (1905)[2] described d'Orbigny's illustration of the said species. This description of the species agrees with that given by the author in the presence of three chambers on one side and two on the other, of spines arranged in longitudinal lines and with little or no apertural neck. Five specimens of the slide (USNM Cat. No. 643464) labelled "*Triloculina echinata* d'Orbigny, 1826, Beach sand, Karachi, India, Earland collection" present at the Geological Survey, United States National Museum, Washington, D.C., are also identical with the species described by the author except that the apertural end is slightly protruding. So far as is known these are the only previous records of this species. It is possible that one can encounter specimens of this species at water depths ranging between 60–80 meters in the Arabian Sea.

The author is grateful to Dr. N. K. Panikkar, Director, National Institute of Oceanography, Panjim, Goa, for advice and encouragement, to Dr. Ruth Todd of the U.S. Geological Survey, Washington, D.C., for helpful comments on this note and to Drs. B. N. Desai and A. P. Setty of National Institute of Oceanography, India, for going through the manuscript.

Biological Oceanography Division,
National Institute of Oceanography,
Bombay, *October* 10, 1969.
K. KAMESWARA RAO.

---

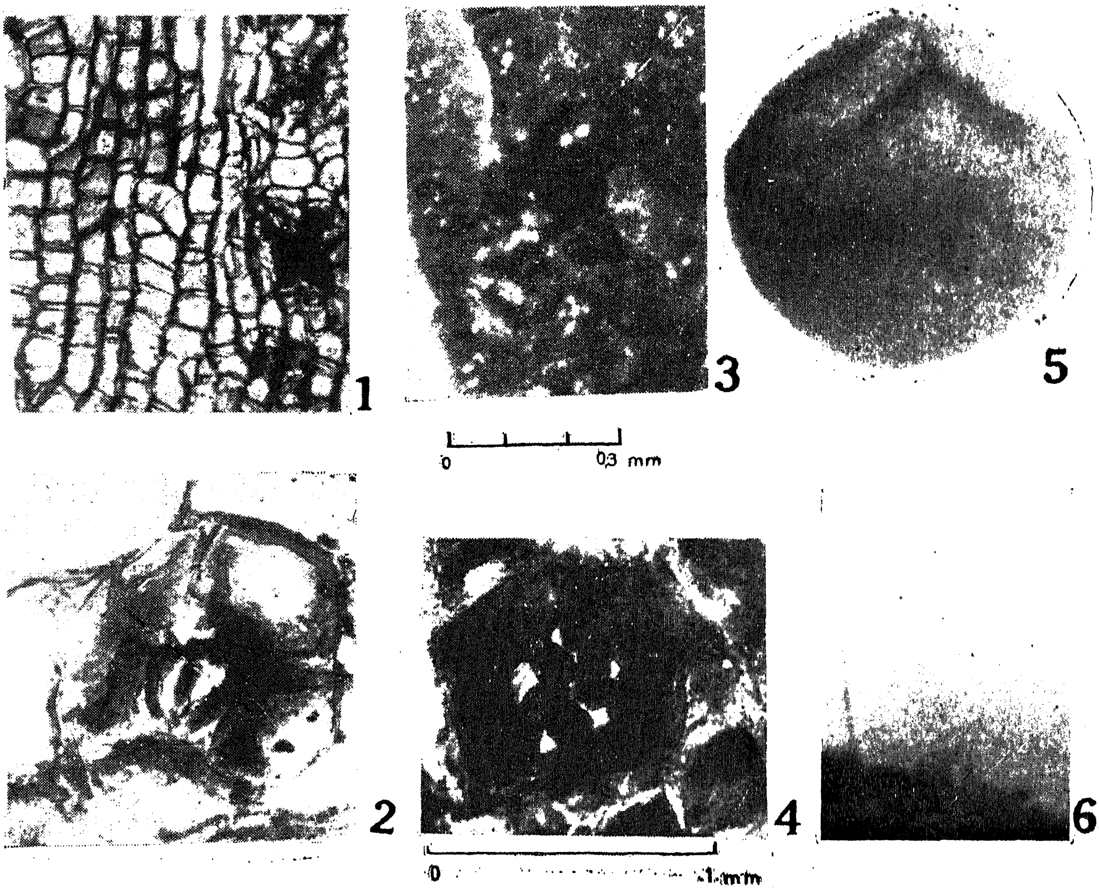
1. d'Orbigny, *Ann. Sc. Nat.*, 1826, **7**(14), 300 (nom nud).
2. Fornasini, *Mem. R. Accad. Sci. Istit. Bologna*, Ser. 6, 1905, **2**, 16, Pl. 1, Fig. 9.

DISCOVERY OF MICROFOSSILS FROM PARASIA COALFIELD, CHHINDWARA DISTRICT, M.P., INDIA

THE microfossils reported here were recovered from a coal sample collected from East Donger Chikli Coal-mine in Parasia. This coal seam is believed to be of lower Gondwana age. On maceration, the coal yielded a large number of well-preserved cuticles, megaspores, microspores and tracheids. Only two well-preserved cuticles and a megaspore are described here.

Glossopteris divergens Feistmantel[3,4] (Figs. 1 and 2).—Epidermal cells rectangular or polygonal, 70 to 80 μ long and 30 to 40 μ broad.

Cell-wall moderately thick and straight. Stomata indefinite, haplocheilic and monocyclic with irregular orientation, 66 to 82 μ in diameter, guard cells two, thickened, 30 μ in length, subsidiary cells 5 and polygonal. This cuticle resembles the cuticle described by P. N. Srivastava.[5]



FIGS. 1–6. Fig. 1. Cuticle of *Glossopteris divergens*. Fig. 2. A stoma of *G. divergens*, Fig. 3. Cuticle of *G. formosa*. Fig. 4. A stoma of *G. farmosa*. Fig. 5. *Triletes subpilosus*, a megaspore. Fig. 6. Exine of *T. subpilosus* showing spine.

G. formosa, Feistmantel[3,4] (Figs. 3 and 4).—Epidermal cells polygonal, longer than broad, 75 × 18 μ. Wall thick and straight, stomata haplocheilic, adjacent stomata generally occur 2–3 cells apart and show irregular orientation. Stoma about 76 μ in diameter. The two-guard cells are not very thickly cutinised, subsidiary cells papillate, polygonal 4 to 7 in number, the papillæ overhang the margins of guard cells. This cuticle resembles the cuticle described as *G. formosa* by P. N. Srivastava[5] except that projecting papillæ here are more prominent.

Triletes subpilosus (Ibrahim) Schopf, Wilson and Bentall, 1944[6] (Sensu Dijkstra, 1946)[1,2] (Figs. 5 and 6).—Bottle-shaped megaspore with distinct apical prominence, spore diameter 460 μ, apical prominence is 242 μ in height from the base of lips, lips thick. Trilete rays are about one-third the radius of spore body. Contact areas and lips are ornamented with spines.

Distal spines long and narrow 70 to 90 μ and 15 to 20 μ. Spines straight, base appears to be hollow, apex pointed or globular. Spines single and without any subsidiary spines. Spore-coat punctate, 7 to 10 μ thick, yellow to orange-brown.

As far as the authors are aware, this is the first report of microfossils from this locality.

Dept. of Botany, B. S. TRIVEDI.
Lucknow University, J. P. MISRA.
Lucknow, *October* 6, 1969.

1. Dijkstra, S. J. and Van Verseen Trip, P. H., *Med. Geol. Sticht. Ser.*, 1946, **C-111-1, 1.**
2. —, "Lower carboniferous megaspores," *Med. Geol. Sticht. Nie. Ser.*, 1950, **10, 5.**
3. Feistmantel, O., "Notes on fossil floras of India," *Rec. Geol. Serv. India*, 1877, **10** (2), 68.
4. —, "Notes on fossil floras of India," *Ibid.*, 1877, **10** (4), 68.
Srivastava, P. N., *The Palæobotanist*, "Studies in the Glossopteris flora of India—4 Glossopteris, Gangamopteris and Palæovittaria from the Raniganj coal field," 1956, **5** (1), 1.
6. Schopf, J. M., Wilson, L. R. and Bentall, R., "An annoted synopsis of Palæozoic fossil spores and the definition of generic groups," *Ill Geol. Surv. Rep.*, **1944, 91, 1.**

A NEW SPECIES OF THE GENUS *BOTRYOSPORIUM* CORDA*

THE present fungus (Fig. 1) was obtained as a contaminant in a sea-water agar plate. It is assigned to the genus *Botryosporium* Corda. The fungus does not resemble any of the presently known species of *Botryosporium* and is hence described as new. The characters as given here are from the fungus growing in a medium containing sea-water, glucose, yeast extract and agar.

Botryosporium madrasense SP. NOV.

The colonies are white, close and adpressed. The conidiophores arise particularly in abundance at the periphery of the colony and at the inner rim of the Petri plate. The conidiophores are erect, hyaline and are up to 4 mm. tall. They are 9·5–15·2 μ broad and sparsely septate. The cells are 35–780 μ long. The conidiophores are acute at the tip. They bear towards the apex fertile lateral stalks which are produced in acropetal succession as the conidiophore keeps growing. They are 47·5–76·0 μ long (Fig. 1, B). The stalks droop slightly towards the base of the conidiophore. Each stalk ends in a terminal vesicle, which is turned upwards (Fig. 1, D). The terminal vesicles are subglobose to pyriform. 15·6–22·8 μ long and 8·4–15·6 μ broad.

The stalk bears below the terminal vesicle one to three lateral vesicles, which usually arise in a whorl. They are slightly larger than the terminal one, being about 19·0–30·0 μ long and 11·4–19·0 μ broad. The terminal vesicle is separated off by a septum from the stalk and the lateral vesicles are similarly separated off from the stalk. The vesicles bear numerous conidia on their entire surface. The conidia (Fig. 1, E) are one-celled, hyaline, elongate, oblong-sub-cylindrical and 12·2–24·0 μ × 4·8–7·3 μ (17·0 × 5·4 μ) with a slightly mamillate base.

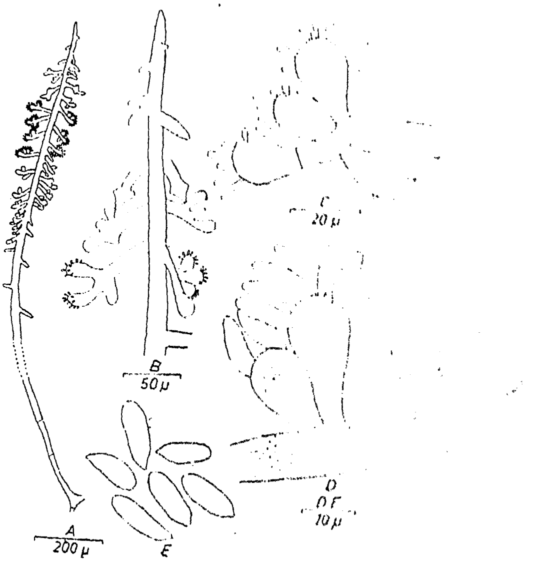


FIG. 1. *Botryosporium madrasense.* A. Habit. B. Terminal portion of a conidiophore; C. Young lateral branch; D. Mature lateral branch; E. Conidia.

The type species of *Botryosporium*, viz., *B. diffusum* (Alb. and Schw.) Corda has globose spores. As pointed out by Mason (1928) there seem to be two distinct species of the genus with elliptic spores or spores other than globose. *Botryosporium pulchrum* Corda (Corda, 1839) has dichotomously branched conidiophores and the conidia-bearing vesicles are simple. In *B. longibrachiatum* (Oudem.) Maire and in my fungus the conidiophores are not dichotomously branched, but are simple. However, the vesicles bearing conidia are lobed in *B. longibrachiatum*, whereas they are simple and globose in my fungus. On the basis of these differences, my fungus is described as a new species.

The fungus when transferred to PDA produced a white felty colony in a week and after about 15 days started producing sclerotial bodies.

Botryosporium madrasense SP. NOV.

Latin diagnosis

Coloniæ adpressæ, albæ. Hyphæ vegetativæ hyalinæ, septatæ, latitudinis 1–2 μ. Conidiophora erecta, non-ramosa, hyalina, distanter septata, altitudinis usque ad 4 mm., latitudinis 9·5–15·2 μ, habentia ramos laterales fecundos in parte altiore, acuto apice. Rami laterales longitudinis 47·5–76·0 μ habentia unum terminalem et 2-3 laterales vesiculas. Vesicula terminalis sursum versa, globosa aut pyriformis, longitudinis 15·6–22·8 μ, latitudinis 8·4–15·6 μ. Vesiculæ laterales 19·0–30·0 × 11·4–19·0 μ. Sporæ latæ in vesiculis, solitariæ, ellipticales ad sub-cylindricales, unicellulares, hyalinæ, 12·2–24·0 × 4·8–7·3 μ.

Typus: collectus in civitate Madras ut contaminans æreus in vase agaro marinæ aquae a S. Raghukumar, February 20, 1969, et depositus in Herbario M.U.B.L. No. 2150.

Developmental Studies.—The stalks arise laterally on the conidiophore in acropetal succession as it grows. The stalks arise as small protuberances from the upper portion of the conidiophore. They show a characteristically drooping aspect from the beginning. Each stalk ends in a terminal vesicle. The lateral vesicles arise as slight protuberances, 1 to 3 in number. As the vesicles enlarge in size, the terminal vesicle is cut off by a septum from the rest of the stalk and assumes its characteristic upwardly bent aspect. Subsequently, the lateral vesicles are also similarly cut off by septa.

Even before the vesicles attain their full size, spore initials appear on them. They are budded out simultaneously from all over the surface of the vesicle.

At this stage, when stained with lactofuchsin, the stalks and the vesicles take up stain uniformly. As the spores attain their final size, the contents of the vesicles gradually disappear and are then poorly stained. With the shedding of the spores, the vesicles lose all their contents, take no stain, and gradually shrivel up; the stalks also shrivel up in turn.

I am very grateful to Prof. C. V. Subramanian for guidance, to Rev. Fr. T. N. Siquiera for the Latin diagnosis and to the University Grants Commission for the award of a Research Fellowship.

Centre for Advanced Studies in Botany,
University Botany Lab.,
Madras-5, India, *October* 16, 1969.

S. Raghukumar.

---

* Memoir No. 78 from the Centre for Advanced Studies in Botany.

1. Corda, A. C. J., *Pracht-Flora europæischer Schimmelbildungen*, Leipzig. and Dresden, 1839.
2. Mason, E. W., "Annotated account of fungi received at the Imperial Bureau of Mycology List II—(Fasicle I)," *Mycol. Pap.*, 1928, **2**, 1.

AN ERYTHROMYCIN-LIKE ANTIBIOTIC PRODUCED BY *STREPTOMYCES GRISEOPLANUS*

Isolation and characterization of an antibiotic, tentatively designated as C-6, from a species of *Streptomyces* was reported by Rangaswami *et al.*[1] This antibiotic has been found to be highly inhibitory to several bacterial plant pathogens including *Pseudomonas solanacearum*, *Xanthomonas malvacearum*, *X. citri* and *X. oryzæ*. In this paper the identity of the antagonistic *Streptomyces* and of the antibiotic are reported.

The morphological, cultural and physiological characters of the antagonistic organism were studied following the standard methods.[2] When the organism was grown on agar slides incubated at 37° C. in moist chambers, following the technique of Gordon and Smith[3] mostly hyaline vegetative mycelium was produced in all media and the aerial mycelium was produced mostly along the periphery of the colonies, except in the inorganic salts-starch agar wherein profuse sporulation was observed all over the colony. The sporophores in the aerial mycelium were either loosely spiralled or wavy and the spores were globose to cylindrical. When grown on nutrient glucose agar it produced scanty, white aerial mycelium, with no soluble pigment in the substratum. On yeast extract agar the vegetative mycelium was colourless to light-brown, aerial mycelium sparse and whitish and no soluble pigment produced. On Czapek's agar the growth was poor and no aerial mycelium was produced. On glucose asparagine agar the aerial mycelium was scanty. On inorganic salts-starch agar the aerial mycelium was white to whitish-grey, but no soluble pigment produced in the medium. On potato plug the vegetative mycelium was hyaline to light brown, ærial mycelium white to gray and the apex of the plug turned slightly brown in ten days. The organism hydrolysed starch to a moderate extent, liquefied gelatin only poorly, and did not produce melanin pigment in organic media. It did not produce H_2S and failed to reduce nitrate. When grown on media containing different carbon sources there was good growth in glucose, xylose, galactose and starch, fair to moderate growth in lactose, maltose, raffinose and glycerol and poor growth in fructose, sucrose, dextrin and mannitol. Based on these characters the organism is identified as *Streptomyces griseoplanus* Backus *et al.*[4,5]

The antagonistic *Streptomyces* was grown in nutrient medium in shake cultures at a constant temperature of 30° C., following the procedure of Rangaswami *et al.*[1] The culture broth was filtered through Whatman No. 1 filter-paper, the filtrate extracted three times with half the volume of ethyl ether and then with *n*-butanol. The two extracts were bulked and evaporated to dryness *in vacuo* at 45° C. in a flash evaporator. The residue was dissolved in ether and the insoluble residue separated by centrifugation. The ether fraction was taken up for chromatographic assay. Thin-layer chromatograms of the antibiotic were developed on silica-gel-G coated plates, using different solvent systems. The active compound on the chromatograms was detected by pouring moulten nutrient agar seeded with *P. solanacearum* and triphenyl tetrazolium chloride at 45° C. and incubating the plates overnight at 30° C. The inhibition zone in the seeded agar, if any, was marked and the R_f value determined. Several other known antibiotics were compared with C-6 on the chromatogram. On the suggestion of Dr. F. M. Strong of the University of Wisconsin, Madison, Wisconsin, U.S.A., who examined the chemical properties of the antibiotic, it was compared with erythromycin, on identical chromatograms and was found to be similar (Fig. 1). While the erythromycin base contained only one fraction as seen in both the solvent systems, C-6 separated into three fractions in the ethanol, water and ammonium hydroxide (80 : 20 : 1) system and into one in the *n*-butanol, acetic acid, water (4 : 1 : 1) system. A comparison of antimicrobial spectrum of the two antibiotics revealed that C-6 is similar to the erythromycin base, both inhibiting several Gram-negative plant pathogenic bacteria but less inhibitory to *Escherichia coli* and *Erwinia carotovora*. The physical and chemical properties of the antibiotic from *S. griseoplanus* are also similar to those of erythromycin.[1-6]

Erythromycin was first isolated from *Streptomyces erythreus* Waksman and Henrici by McGuire *et al.*[6] and since then at least three derivatives of the antibiotic, *viz.*. erythromycin A, B and C, have so far been differentiated.[7-10] In the TLC developed with ether extracts of the antibiotic obtained from *S. griseoplanus*, three different active fractions were obtained (Fig. 1). It is possible that this streptomycete isolate produced more than one derivative of erythromycin or other closely related antibiotics and further detailed studies are required to isolate and identify these fractions.

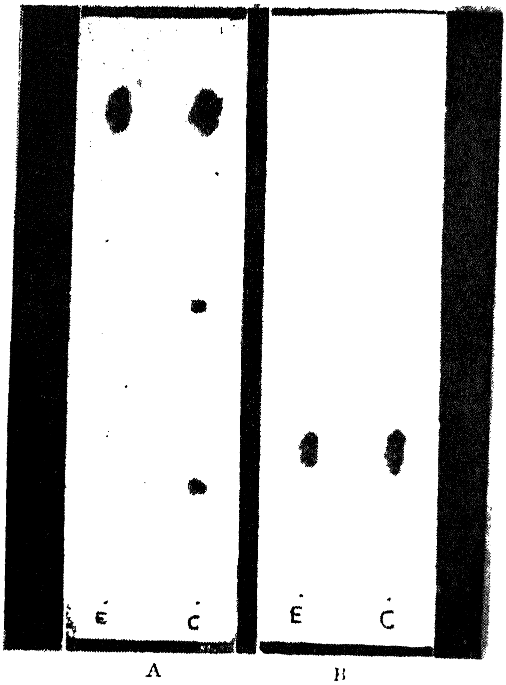


FIG. 1. Thin layer chromatographic comparison of erythromycin base and the crude antibiotic (C 6): Solvent systsms for A: ethanol : H_2O : NH_4OH :: 80 : 20 : 1 ; for B: *n*-butanol : acetic acid : H_2O :: 4 : 1 : 1; E : erythromycin base and C: ether extract of C 6.

The inhibitory effect of erythromycin against some of the virulent plant pathogenic bacteria is of considerable interest. In another paper from this laboratory the effective control of brown rot of potato caused by *P. solanacearum* with the antibiotic has been reported.[11]

Microbiology Dept.,
University of
Agri. Sciences,
Hebbal, Bangalore-24,
October 15, 1969.

KUNTHALA JAYARAMAN.
G. OBLISAMI.
G. RANGASWAMI.

---

1. Rangaswami, G., Oblisami, G. and Swaminathan, R., *Antagonistic Actinomycetes in the Soils of South India*, Univ. Agri. Sci., Bangalore, 1967, p. 103.
2. Anonymous, *Manual of Microbiological Methods*, McGraw-Hill Book, Co., Inc., New York, 1957.
3. Gordon, R. E. and Smith, M. M., *J. Bacteriol.*, 1955, **66**, 147.
4. Backus, E. J., Tresner, H. D. and Campbell, T. H., *Antibiot. and Chemother.*, 1957, 7, 532.
5. Waksman, S. A., *The Actinomycets*, Williams & Wilkins Co., Baltimore, 1961, 2.

6. McGuire, J. M., Bunch, R. L., Anderson, R. C., Boaz, H. E., Flynn E. H., Powell, H. M. and Smith, J. M., *Antibiot. and Chemother.*, 1952, **2**, 281.
7. Wiley, P. F., Sigal, M. V. Jr., Weaver, O., Monahan, R. and Gerzon, K., *J. Am. Chem. Soc.*, 1957, **79**, 6070.
8. Wiley, P. F., Gale, R., Pettinga, C. W. and Gerzon, K., *Ibid.*, 1957, **79**, 6074.
9. Grundy, W. E., Alford, E. F., Ricker, C. J., Bower, R. R., Rdzok, E. J. and Sylvester, J. C., *Antibiot. and Chemother.*, 1955, **5**, 212.
10. Waksman, S. A. and Lechevalier, H. A., *The Actinomycetes* Williams & Wilkins, Baltimore, 1962, **3**.
11. Shetty, K. S. and Rangaswami, G., *Mysore J. Agri. Sci.*, 1969, **3**, 323.

NODULATION UNDER UNFAVOURABLE SOIL CONDITIONS

PELLETING inoculated legume seed is not in vogue in this country although this method is being practised extensively in U.S.A., New Zealand and Australia. The pelleted seed enhances the survival of *Rhizobium* on the seed and some of the hazards associated with problem soils like absence of nodulation, delayed germination and desiccation are removed[2,4,8,11]. By this method Murguia and Date[11] could obtain 67·87% nodulation in soil where rain failed for 45 days after sowing. Under low pH conditions the bacteria are also poisoned by the soluble metallic ion like Mn (Dovereiner *et al.*[3]). Further, toxicity due to excess of soluble Al or Fe may also affect the survival. The difficulty could be overcome by liming or more economically by lime pelleting the inoculated seed. Various powders such as lime (carbonate), bentonite clay, clay lime mixtures, charcoal and rock phosphate have been used as pelleting or coating materials[1,3,6,9].

Failure of inoculation of soybean with imported and indigenous ones in soil at Suratgarh has been reported. In acid soils like that at Palampur, a similar situation is likely to occur. In order to overcome this, soybean seeds (var Bragg) pelleted with lime or rock phosphate using Indian peat culture[10] containing *Rhizobium japonicum* S.B. 16 isolated locally and maintained in this Division were sown in the experiment described below, following the method of Hastings[7] with the modification that sugar was included among the constituents.

Soil core from Suratgarh (pH 8·1) and well-mixed soil sample from Palampur (pH 4·9) were used. Soybean inoculated with peat culture constituted the control while the other two treatments consisted of seeds pelleted with lime and rock phosphate. In the case of Palampur soil only lime-pelleted treatment was used because of high acidity. Both the soils were treated with a basal dressing of P_2O_5, 100·0; $ZnSO_4$, 1·0; $MnSO_4$, 1·0; Borax, 1·0; Ammonium molybdate, 0·5 Kg./H. Duplicate sets were maintained in each treatment, each pot having four plants in the case of Suratgarh soil and three plants in Palampur soil. At the time of sowing the initial *Rhizobium* count was 16×10^5/seed.

Lime and rock phosphate pelleted seeds germinated within 4 days of sowing while the germination was delayed by 8 and 13 days in the peat culture treated seeds in Suratgarh and Palampur respectively. The overall growth of the plants in the pelleted ones was good. The plants were uprooted after 8 weeks. The nodulation pattern and dry yields of the crop are given in Table I.

TABLE I

Nodulation of plants from non-pelleted and pelleted seeds and their yields in Suratgarh and Palampur soils

Treatment	Suratgarh		Palampur	
	Nodulation	Average yield (g/plant)	Nodulation	Average yield (g/plant)
Inoculated and non pelleted	+	1·80	+	4·9
Inoculated and lime-pelleted	++	3·46	+++	7·7
Inoculated and rock phosphate pelleted	++	3·23	—	—

+ Fair nodulation; ++ Good nodulation; +++ Excellent nodulation.

The results show the beneficial effects of pelleting the seeds and using them in such soils. The seed pelleting treatments reacted best with inoculation. The nodulation and dry weight per plant increased with both lime and rock phosphate pelleting. There are some unknown factors related to soil conditions which restrict the development of nodules in legumes. Pelleting in all possibility has a protective influence against these factors particularly pH as can be seen in the present study. Pelleting materials also help in suppressing the effect of toxic substances present in the soil and thereby might help the organisms to infect the

plants effectively leading to better nodulation and crop yield.

Div. of Microbiology, V. ISWARAN.
Indian Agricultural W. V. B. SUNDARA RAO.
Research Institute, K. S. JAUHRI.
New Delhi-12,
October 14, 1969.

1. Bergersen, F. J., Brockwell, J. and Thompson, J. A. *Jour. Aust. Inst. Agri. Sci.*, 1958, **24**, 158.
2. Brockwell, J. and Whalley, R. D. B., *Aust. J. Sci.*, 1962, **24**, 458.
3. —. *Aust. J. Agri. Res.*, 1962, **13**, 638.
4. Cass Smith, W. P. and Goss, O.M., *J. Agri. Western Aust.*, Ser. 3, 1958, **7**, 119.
5. Dovereiner, J., Arruda, N. B. D. and Pentcado, A., de, F., *Proc. 9th Int. Grasslands Congr.*, 1966, **3**, 1153.
6. Hastings, A., *J. Agric.*, 1962, **104**, 330.
7. —, *New Zealand Fmr.*, 1962 A, **83**, 20.
8. —, *New Zealand J. Agric.*, 1963, **106**, 463.
9. —, and Drake, A. D., *Ibid.*, 1960, **101**, 619.
10. Iswaran, V., Sundara Rao, W. V. B., Magu, S. P. and Jauhri, K. S., *Curr. Sci.*, 1969, **38** (19), 468.
11. Loneragan, J. F., Meyer, D., Fawcett, R. G. and Anderson, A, J., *J. Aust. Inst. Agric. Sci.*, 1955, **21**, 264.
12. Murguia, J. L. and Date, R A., *Proc. 9th Intern. Glassland Congr. Brazil*, 1965, **1** (2), 279.

GENETICS OF VEINAL NECROSIS IN POTATO

PARENTAL lines obtained from Scottish Society for Research in Plant Breeding (through Dr. W. Black) have been under study at the Central Potato Research Institute, Simla, for the last few years. These lines have been observed to show veinal necrosis under glass-house conditions regularly. These symptoms have also been observed and reported from the Netherlands in the Scottish material by Thijn.[1] He has reported the veinal necrosis to be a heritable symptom controlled probably by many genetic factors showing a complex inheritance. The plant population showing veinal necrosis reported here, was tested for the possibility of virus Y and was found to be free of this virus infection.

In order to determine the inheritance of this character. two crosses were made among four of the lines, and one of the selections from an earlier cross between the lines was also selfed. The cross and the self seeds were germinated in petri dishes and the seedlings transplanted in pots with sterilized soil and grown under glass-house conditions. Beginning from the two or three leaf stage upto full maturity, the plants were observed for veinal necros and the segregations for the character recor ed. The data along with the χ^2 values for tl observed ratios are given in Table I.

TABLE I

Sr. No.	Crosses	Observed frequency: Without veinal necrosis	Observed frequency: With veinal necrosis	Total no. of plants	Expected ratio	χ^2 values
1	CP 1516 × CP 1539	303	24	327	15 : 1	0·66
2	CP 1633 × CP 1537	427	23	450	15 : 1	0·99
3	Self progeny of a selection F_1-187 (from the crosses CP 1503 × CP 1499)	650	210	860	3 : 1	0·155

χ^2 df$_1$ at 0·05 = 3·841.

The crosses 1 and 2 give a clear indication of the presence of two independent recessive factors, whereas the selfed progeny of a selection (F_1-187) from the cross CP 1503 × CP 1499 showed the segregation for one recessive factor, for the expression of veinal necrosis. To establish whether these factors are common among the parents used, crosses in all the possible combinations using only the fertile lines as the male parents have been attempted and the detailed information will be published later.

The parental lines were derived from crosses between *S. tuberosum* and *demissum* and *phureja*, similar to the Scottish material studied by Thijn.[1] His conclusions that the factors involved might have been derived from either *demissum* or *phureja* parents, may be possible. But this conclusion needs confirmation because no such wild blood seems to be responsible for the symptoms observed in material studied by Scholz *et al.*[2]

We are thankful to Mr. Lallan Giri for testing the plants biologically for virus Y.

Central Potato Research R. T. SHARDA.
Institute, M. D. UPADHYA.
Simla, India, S. K. ANAND.
October 21, 1969. HARI KISHORE.

---

1. Thijn, G. A., *Meded Nea. Alg.* Keur, Dienst Landb Zaken Aardappelpootg, **1965**, **22**, 58.
2. Scholz, Von, M., Menil, G. and Schreiter, J., *Nachr. BL. dt. Pfl Schutzdienst*, Berl., **1964**, **6**, 166.

REVIEWS AND NOTICES OF BOOKS

Introduction to Technical Mathematics. By Allyn J. Washington. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W.1, England), 1969. Pp. xii + 464. Price 79 *sh.*

This text was written to satisfy the ever-increasing need for fundamental material for technical and "pre-technical" mathematics curricula. This book introduces the subject through a review of arithmetical operations prior to introducing traditional topics in algebra, geometry, and trigonometry.

The contents of this book are: Fundamentals from Arithmetic; Measurement and Approximate Numbers; Introduction to the Slide Rule; Signed Numbers; Introduction to Algebra; Simple Equations; Introduction to Geometry; Basic Algebraic Operations; Factorising; Exponents, Roots and Radicals; Quadratic Equations; Logarithms; Graphs; Simultaneous Linear Equations; Additional Topics from Geometry; and Introduction to Trigonometry.

There are over 3,600 problem-solving exercises taken from a wide selection of technical fields.

The text is particularly suitable for those students whose scholastic preparation does not meet the required level to insure success in a technical program.

The author enhances the theme of his earlier books, *Basic Technical Mathematics*, and *Basic Technical Mathematics with Calculus*, of teaching technical mathematics through illustrative examples, stated word problems, and repetitive drill.

C. V. R.

Citric Acid Cycle Control and Compartmentation. Edited by John M. Lowenstein. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xxi + 366. Price $ 17.75, Sterling Price £ 8-8-0.

The citric acid cycle was first proposed by Krebs and Johnson in 1937 to account for the terminal stages of oxidation of carbohydrate to carbon dioxide and water.. This book brings together current ideas and work on the control of the citric acid cycle. It will bridge the gap between the text-book view of the cycle and current work concerning its regulation and compartmentation.

The chapters in this volume show that our understanding of the citric acid cycle is far from complete. The functional complexity of the cycle is much greater than was recognized even ten years ago. The topics now under intense investigation include the intracellular compartmentation of the enzymes and substrates of the cycle, the specific functions of intra- and extra-mitochondrial portions of the cycle, and the specific functions of multiple alternative reactions which occur in the cycle. Each chapter covers a different area of the citric acid cycle, but the emphasis throughout is on current problems.

This book under review is directed to graduate students and biochemists who wish to become acquainted with current problems in the field.

C. V. R.

Vibration and Impact. By Ralph Burton. (Dover Publications, Inc., 180, Varick Street, New York), 1969. Pp. x + 310. Price $ 2.75.

This text, designed for senior and introductory graduate courses, is a broad introduction to the subject. It will serve as a stepping stone between introductory dynamics and the more advanced fields of engineering analysis. The manner of presentation reflects the writer's view that an understanding of basic principles of vibration (and oscillatory phenomena in general) is needed by engineering students, regardless of what their special interests may be.

The author draws upon a gradual sequence of physical concepts in his presentation, so that no mathematics beyond the calculus is needed to follow relatively advanced topics. Following the introduction (the vibrating string, harmonics, waves, the role of vibration analysis on design, and other basics) are chapters on free vibration, vibrating systems commonly found in machinery, damping, steady forced vibration, impact, non-linear vibration, measurement (instruments and analogs), systems with two degrees of freedom, numerical computation of natural frequencies for systems with many degrees of freedom, waves, vibrating beams, analysis of control systems, and fatigue. Such topics as transient phenomena, self-excited vibration, and control systems are included.

A large number of worked and unworked problems are distributed throughout the text, ranging from simple applications of theory to

[illegible] leading to better nodulation [illegible]

Division of Microbiology, | V. Iswaran.
Indian Agricultural | W. V. B. Sundara Rao.
Research Institute, | K. S. Jauhri.
New Delhi-12,
October 14, 1969.

---

1. Bergersen, F. J., Brockwell, J. and Thompson, J. A., *J. Aust. Inst. Agri. Sci.*, 1958, **24**, 158.
2. Brockwell, J. and Whalley, R. D. B., *Aust. J. Sci.*, 1962, **24**, 458.
3. —, *Aust. J. Agri. Res.*, 1962, **13**, 638.
4. Cass Smith, W. P. and Goss, O.M., *J. Agri. Western Aust.*, Ser. 3, 1958, **7**, 119.
5. Döbereiner, J., Arruda, N. B. D. and Penteado, A. de F., *Proc. 9th Int. Grasslands Congr.*, 1966, **3**, 1123.
6. Hastings, A., *J. Agric.*, 1962, **104**, 330.
7. —, *New Zealand Fmr.*, 1962 A, **83**, 20.
8. —, *New Zealand J. Agric.*, 1963, **106**, 463.
9. — and Drake, A. D., *Ibid.*, 1960, **101**, 619.
10. Iswaran, V., Sundara Rao, W. V. B., Magu, S. P. and Jauhri, K. S., *Curr. Sci.*, 1969, **38** (19), 468.
11. Loneragan, J. F., Meyer, D., Fawcett, R. G. and Anderson, A. J., *J. Aust. Inst. Agric. Sci.*, 1955, **21**, 264.
12. [illegible], J. L. and Date, R. A., *Proc. 9th Intern. Grassland Congr. Brazil*, 1965, **1** (2), 279.

GENETICS OF VEINAL NECROSIS IN POTATO

Parental lines obtained from Scottish Society for Research in Plant Breeding (through Dr. W. Black) have been under study at the Central Potato Research Institute, Simla, for the last few years. These lines have been observed to show veinal necrosis under glass-house conditions regularly. These symptoms have also been observed and reported from the Netherlands in the Scottish material by Thijn.[1] He has reported the veinal necrosis to be a heritable symptom controlled probably by many genetic factors showing a complex inheritance. The plant population showing veinal necrosis reported here, was tested for the possibility of virus Y and was found to be free of this virus infection.

In order to determine the inheritance of this character, two crosses were made among four of the lines, and one of the selections from an earlier cross between the lines was also selfed. The cross and the self seeds were germinated in petri dishes and the seedlings transplanted in pots with sterilized soil and grown under glass-house conditions. Beginning from the two or three leaf stage upto full maturity, the plants were observed for veinal necrosis and the segregations for the character recorded. The data along with the χ^2 values for the observed ratios are given in Table I.

TABLE I

Sr. No.	Crosses	Observed frequency		Total no. of plants	Expected ratio	χ^2 values
		Without veinal necrosis	With veinal necrosis			
1	CP 1516 × CP 1539	303	24	327	15 : 1	0·662
2	CP 1633 × CP 1537	427	23	450	15 : 1	0·996
3	Self progeny of a selection F_1-187 (from the crosses CP 1503 × CP 1499)	650	210	860	3 : 1	0·155

χ^2 df$_1$ at 0·05 = 3·841.

The crosses 1 and 2 give a clear indication of the presence of two independent recessive factors, whereas the selfed progeny of a selection (F_1-187) from the cross CP 1503 × CP 1499 showed the segregation for one recessive factor, for the expression of veinal necrosis. To establish whether these factors are common among the parents used, crosses in all the possible combinations using only the fertile lines as the male parents have been attempted and the detailed information will be published later.

The parental lines were derived from crosses between *S. tuberosum* and *demissum* and *phureja*, similar to the Scottish material studied by Thijn.[1] His conclusions that the factors involved might have been derived from either *demissum* or *phureja* parents, may be possible. But this conclusion needs confirmation because no such wild blood seems to be responsible for the symptoms observed in material studied by Scholz *et al.*[2]

We are thankful to Mr. Lallan Giri for testing the plants biologically for virus Y.

Central Potato Research Institute, | R. T. Sharda.
Simla, India, | M. D. Upadhya.
October 21, 1969. | S. K. Anand.
Hari Kishore.

---

1. Thijn, G. A., *Meded Nat. Alg.* Keur, Dienst Landb Zaken Aardappelpootg, 1965, **22**, 58.
2. Scholz, Von, M., Menil, G. and Schreiter, J., *Nachr. BL. dt. Pfl Schutzdienst*, Berl., 1964, **6**, 166.

REVIEWS AND NOTICES OF BOOKS

Introduction to Technical Mathematics. By Allyn J. Washington. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W.1, England), 1969. Pp. xii + 464. Price 79 *sh.*

This text was written to satisfy the ever-increasing need for fundamental material for technical and "pre-technical" mathematics curricula. This book introduces the subject through a review of arithmetical operations prior to introducing traditional topics in algebra, geometry, and trigonometry.

The contents of this book are: Fundamentals from Arithmetic; Measurement and Approximate Numbers; Introduction to the Slide Rule; Signed Numbers; Introduction to Algebra; Simple Equations; Introduction to Geometry; Basic Algebraic Operations; Factorising; Exponents, Roots and Radicals; Quadratic Equations; Logarithms; Graphs; Simultaneous Linear Equations; Additional Topics from Geometry; and Introduction to Trigonometry.

There are over 3,600 problem-solving exercises taken from a wide selection of technical fields.

The text is particularly suitable for those students whose scholastic preparation does not meet the required level to insure success in a technical program.

The author enhances the theme of his earlier books, *Basic Technical Mathematics*, and *Basic Technical Mathematics with Calculus*, of teaching technical mathematics through illustrative examples, stated word problems, and repetitive drill.

C. V. R.

Citric Acid Cycle—Control and Compartmentation. Edited by John M. Lowenstein. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xxi + 366. Price $17.75; Sterling Price £ 8-8-0.

The citric acid cycle was first proposed by Krebs and Johnson in 1937 to account for the terminal stages of oxidation of carbohydrate to carbon dioxide and water.. This book brings together current ideas and work on the control of the citric acid cycle. It will bridge the gap between the text-book view of the cycle and current work concerning its regulation and compartmentation.

The chapters in this volume show that our understanding of the citric acid cycle is far from complete. The functional complexity of the cycle is much greater than was recognized even ten years ago. The topics now under intense investigation include the intracellular compartmentation of the enzymes and substrates of the cycle, the specific functions of intra- and extra-mitochondrial portions of the cycle, and the specific functions of multiple alternative reactions which occur in the cycle. Each chapter covers a different area of the citric acid cycle, but the emphasis throughout is on current problems.

This book under review is directed to graduate students and biochemists who wish to become acquainted with current problems in the field.

C. V. R.

Vibration and Impact. By Ralph Burton. (Dover Publications, Inc., 180, Varick Street, New York), 1969. Pp. x + 310. Price $2.75.

This text, designed for senior and introductory graduate courses, is a broad introduction to the subject. It will serve as a stepping-stone between introductory dynamics and the more advanced fields of engineering analysis. The manner of presentation reflects the writer's view that an understanding of basic principles of vibration (and oscillatory phenomena in general) is needed by engineering students, regardless of what their special interests may be.

The author draws upon a gradual sequence of physical concepts in his presentation, so that no mathematics beyond the calculus is needed to follow relatively advanced topics. Following the introduction (the vibrating string, harmonics, waves, the role of vibration analysis on design, and other basics) are chapters on free vibration, vibrating systems commonly found in machinery, damping, steady forced vibration, impact, non-linear vibration, measurement (instruments and analogs), systems with two degrees of freedom, numerical computation of natural frequencies for systems with many degrees of freedom, waves, vibrating beams, analysis of control systems, and fatigue. Such topics as transient phenomena, self-excited vibration, and control systems are included.

A large number of worked and unworked problems are distributed throughout the text, ranging from simple applications of theory to

[illegible] leading to better nodulation [illegible]

Division of Microbiology, V. Iswaran.
Indian Agricultural W. V. B. Sundara Rao.
Research Institute, K. S. Jauhri.
New Delhi-12,
[illegible] 14, 1969.

---

1. Bergersen, F. J., Brockwell, J. and Thompson, J. A., *J. Aust. Inst. Agri. Sci.*, 1958, **24**, 158.
2. Brockwell, J. and Whalley, R. D. B., *Aust. J. Sci.*, 1962, **24**, 458.
3. —, *Aust. J. Agri. Res.*, 1962, **13**, 638.
4. Cass Smith, W. P. and Goss, O. M., *J. Agri. Western Aust.*, Ser. 3, 1958, **7**, 119.
5. Döbereiner, J., Arruda, N. B. D. and Pentcado, A., de F., *Proc. 9th Int. Grasslands Congr.*, 1966, **3**, 1153.
6. Hastings, A., *N.Z. J. Agric.*, 1962, **104**, 330.
7. —, *New Zealand Fmr.*, 1962 A, **83**, 20.
8. —, *New Zealand J. Agric.*, 1963, **106**, 463.
9. — and Drake, A. D., *Ibid.*, 1960, **101**, 619.
10. Iswaran, V., Sundara Rao, W. V. B., Magu, S. P. and Jauhri, K. S., *Curr. Sci.*, 1969, **38** (19), 468.
11. Loneragan, J. F., Meyer, D., Fawcett, R. G. and Anderson, A. J., *J. Aust. Inst. Agric. Sci.*, 1955, **21**, 264.
12. [illegible], J. L. and Date, R. A., *Proc. 9th Intern. Grassland Congr. Brazil*, 1965, **1** (2), 279.

GENETICS OF VEINAL NECROSIS IN POTATO

Parental lines obtained from Scottish Society for Research in Plant Breeding (through Dr. W. Black) have been under study at the Central Potato Research Institute, Simla, for the last few years. These lines have been observed to show veinal necrosis under glass-house conditions regularly. These symptoms have also been observed and reported from the Netherlands in the Scottish material by Thijn.[1] He has reported the veinal necrosis to be a heritable symptom controlled probably by many genetic factors showing a complex inheritance. The plant population showing veinal necrosis reported here, was tested for the possibility of virus Y and was found to be free of this virus infection.

In order to determine the inheritance of this character, two crosses were made among four of the lines, and one of the selections from an earlier cross between the lines was also selfed. The cross and the self seeds were germinated in petri dishes and the seedlings transplanted in pots with sterilized soil and grown under glass-house conditions. Beginning from the two or three leaf stage upto full maturity, the plants were observed for veinal necrosis and the segregations for the character recorded. The data along with the χ^2 values for the observed ratios are given in Table I.

TABLE I

Sr. No.	Crosses	Observed frequency		Total no. of plants	Expected ratio	χ^2 values
		Without veinal necrosis	With veinal necrosis			
1	CP 1516 × CP 1539	303	24	327	15 : 1	0·662
2	CP 1633 × CP 1537	427	23	450	15 : 1	0·996
3	Self progeny of a selection F_1-187 (from the crosses CP 1503 × CP 1499)	650	210	860	3 : 1	0·155

χ^2 df_1 at 0·05 = 3·841.

The crosses 1 and 2 give a clear indication of the presence of two independent recessive factors, whereas the selfed progeny of a selection (F_1-187) from the cross CP 1503 × CP 1499 showed the segregation for one recessive factor, for the expression of veinal necrosis. To establish whether these factors are common among the parents used, crosses in all the possible combinations using only the fertile lines as the male parents have been attempted and the detailed information will be published later.

The parental lines were derived from crosses between *S. tuberosum* and *demissum* and *phureja*, similar to the Scottish material studied by Thijn.[1] His conclusions that the factors involved might have been derived from either *demissum* or *phureja* parents, may be possible. But this conclusion needs confirmation because no such wild blood seems to be responsible for the symptoms observed in material studied by Scholz *et al.*[2]

We are thankful to Mr. Lallan Giri for testing the plants biologically for virus Y.

Central Potato Research Institute, R. T. Sharda.
Simla, India, M. D. Upadhya.
October 21, 1969. S. K. Anand.
Hari Kishore.

---

1. Thijn, G. A., *Meded Ned. Alg. Keur*, Dienst Landb Zaken Aardappelpootg, 1965, **22**, 58.
2. Scholz, Von, M., Menil, G. and Schreiter, J., *Nachr. BL. dt. Pfl Schutzdienst*, Berl., 1964, **6**, 166.

REVIEWS AND NOTICES OF BOOKS

Introduction to Technical Mathematics. By Allyn J. Washington. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W.1, England), 1969. Pp. xii + 464. Price 79 *sh.*

This text was written to satisfy the ever-increasing need for fundamental material for technical and "pre-technical" mathematics curricula. This book introduces the subject through a review of arithmetical operations prior to introducing traditional topics in algebra, geometry, and trigonometry.

The contents of this book are: Fundamentals from Arithmetic; Measurement and Approximate Numbers; Introduction to the Slide Rule; Signed Numbers; Introduction to Algebra; Simple Equations; Introduction to Geometry; Basic Algebraic Operations; Factorising; Exponents, Roots and Radicals; Quadratic Equations; Logarithms; Graphs; Simultaneous Linear Equations; Additional Topics from Geometry; and Introduction to Trigonometry.

There are over 3,600 problem-solving exercises taken from a wide selection of technical fields.

The text is particularly suitable for those students whose scholastic preparation does not meet the required level to insure success in a technical program.

The author enhances the theme of his earlier books, *Basic Technical Mathematics*, and *Basic Technical Mathematics with Calculus*, of teaching technical mathematics through illustrative examples, stated word problems, and repetitive drill.

C. V. R.

Citric Acid Cycle—Control and Compartmentation. Edited by John M. Lowenstein. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xxi + 366. Price $ 17.75; Sterling Price £ 8-8-0.

The citric acid cycle was first proposed by Krebs and Johnson in 1937 to account for the terminal stages of oxidation of carbohydrate to carbon dioxide and water.. This book brings together current ideas and work on the control of the citric acid cycle. It will bridge the gap between the text-book view of the cycle and current work concerning its regulation and compartmentation.

The chapters in this volume show that our understanding of the citric acid cycle is far from complete. The functional complexity of the cycle is much greater than was recognized even ten years ago. The topics now under intense investigation include the intracellular compartmentation of the enzymes and substrates of the cycle, the specific functions of intra- and extra-mitochondrial portions of the cycle, and the specific functions of multiple alternative reactions which occur in the cycle. Each chapter covers a different area of the citric acid cycle, but the emphasis throughout is on current problems.

This book under review is directed to graduate students and biochemists who wish to become acquainted with current problems in the field.

C. V. R.

Vibration and Impact. By Ralph Burton. (Dover Publications, Inc., 180, Varick Street, New York), 1969. Pp. x + 310. Price $ 2.75.

This text, designed for senior and introductory graduate courses, is a broad introduction to the subject. It will serve as a stepping-stone between introductory dynamics and the more advanced fields of engineering analysis. The manner of presentation reflects the writer's view that an understanding of basic principles of vibration (and oscillatory phenomena in general) is needed by engineering students, regardless of what their special interests may be.

The author draws upon a gradual sequence of physical concepts in his presentation, so that no mathematics beyond the calculus is needed to follow relatively advanced topics. Following the introduction (the vibrating string, harmonics, waves, the role of vibration analysis on design, and other basics) are chapters on free vibration, vibrating systems commonly found in machinery, damping, steady forced vibration, impact, non-linear vibration, measurement (instruments and analogs), systems with two degrees of freedom, numerical computation of natural frequencies for systems with many degrees of freedom, waves, vibrating beams, analysis of control systems, and fatigue. Such topics as transient phenomena, self-excited vibration, and control systems are included.

A large number of worked and unworked problems are distributed throughout the text, ranging from simple applications of theory to

plants effectively leading to better nodulation and crop yield.

Div. of Microbiology, V. Iswaran.
Indian Agricultural W. V. B. Sundara Rao.
Research Institute, K. S. Jauhri.
New Delhi-12,
October 14, 1969.

---

1. Bergersen, F. J., Brockwell, J. and Thompson, J. A. *Jour. Aust. Inst. Agri. Sci.*, 1958, **24**, 158.
2. Brockwell, J. and Whalley, R. D. B., *Aust. J. Sci.*, 1962, **24**, 458.
3. —. *Aust. J. Agri. Res.*, 1962, **13**, 638.
4. Cass Smith, W. P. and Goss, O.M., *J. Agri. Western Aust.*, Ser. 3, 1958, **7**, 119.
5. Dovereiner, J., Arruda, N. B. D. and Pentcado, A., de, F., *Proc. 9th Int. Grasslands Congr.*, 1966, **3**, 1153.
6. Hastings, A., *J. Agric.*, 1962, **104**, 330.
7. —, *New Zealand Fmr.*, 1962 A, **83**, 20.
8. —, *New Zealand J. Agric.*, 1963, **106**, 463.
9. —, and Drake, A. D., *Ibid.*, 1960, **101**, 619.
10. Iswaran, V., Sundara Rao, W. V. B., Magu, S. P. and Jauhri, K. S., *Curr. Sci.*, 1969, **38** (19), 468.
11. Loneragan, J. F., Meyer, D., Fawcett, R. G. and Anderson, A, J., *J. Aust. Inst. Agric. Sci.*, 1955, **21**, 264.
12. Murguia, J. L. and Date, R A., *Proc. 9th Intern. Glassland Congr. Brazil*, 1965, **1** (2), 279.

GENETICS OF VEINAL NECROSIS IN POTATO

Parental lines obtained from Scottish Society for Research in Plant Breeding (through Dr. W. Black) have been under study at the Central Potato Research Institute, Simla, for the last few years. These lines have been observed to show veinal necrosis under glass-house conditions regularly. These symptoms have also been observed and reported from the Netherlands in the Scottish material by Thijn.[1] He has reported the veinal necrosis to be a heritable symptom controlled probably by many genetic factors showing a complex inheritance. The plant population showing veinal necrosis reported here, was tested for the possibility of virus Y and was found to be free of this virus infection.

In order to determine the inheritance of this character. two crosses were made among four of the lines, and one of the selections from an earlier cross between the lines was also selfed. The cross and the self seeds were germinated in petri dishes and the seedlings transplanted in pots with sterilized soil and grown under glass-house conditions. Beginning from the two or three leaf stage upto full maturity, the plants were observed for veinal necrosis and the segregations for the character recorded. The data along with the χ^2 values for the observed ratios are given in Table I.

Table I

Sr. No.	Crosses	Observed frequency		Total no. of plants	Expected ratio	χ^2 values
		Without veinal necrosis	With veinal necrosis			
1	CP 1516 × CP 1539	303	24	327	15 : 1	0·662
2	CP 1633 × CP 1537	427	23	450	15 : 1	0·996
3	Self progeny of a selection F_1-187 (from the crosses CP 1503 × CP 1499)	650	210	860	3 : 1	0·155

χ^2 df_1 at 0·05 = 3·841.

The crosses 1 and 2 give a clear indication of the presence of two independent recessive factors, whereas the selfed progeny of a selection (F_1-187) from the cross CP 1503 × CP 1499 showed the segregation for one recessive factor, for the expression of veinal necrosis. To establish whether these factors are common among the parents used, crosses in all the possible combinations using only the fertile lines as the male parents have been attempted and the detailed information will be published later.

The parental lines were derived from crosses between *S. tuberosum* and *demissum* and *phureja*, similar to the Scottish material studied by Thijn.[1] His conclusions that the factors involved might have been derived from either *demissum* or *phureja* parents, may be possible. But this conclusion needs confirmation because no such wild blood seems to be responsible for the symptoms observed in material studied by Scholz *et al.*[2]

We are thankful to Mr. Lallan Giri for testing the plants biologically for virus Y.

Central Potato Research R. T. Sharda.
Institute, M. D. Upadhiya.
Simla, India, S. K. Anand.
October 21, 1969. Hari Kishore.

---

1. Thijn, G. A., *Meded Nea. Alg.* Keur, Dienst Landb Zaken Aardappelpootg, 1965, **22**, 58.
2. Scholz, Von, M., Menil, G. and Schreiter, J., *Nachr. BL. dt. Pfl Schutzdienst*, Berl., 1964, **6**, 166.

REVIEWS AND NOTICES OF BOOKS

Introduction to Technical Mathematics. By Allyn J. Washington. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W.1, England), 1969. Pp. xii + 464. Price [illegible].

This text was written to satisfy the ever increasing need for fundamental material for technical and 'pre-technical' mathematics curricula. This book introduces the subject through a review of arithmetical operations prior to introducing traditional topics in algebra, geometry, and trigonometry.

The contents of the book are: Fundamentals from Arithmetic, Measurement and Approximate Numbers, Introduction to the Slide Rule, Signed Numbers, Introduction to Algebra, Simple Equations, Introduction to Geometry, Basic Algebraic Operations, Factoring, Exponents, Roots and Radicals, Quadratic Equations, Logarithms, Graphs, Simultaneous Linear Equations, Additional Topics from Geometry, and Introduction to Trigonometry.

There are over 4,000 problems which, [illegible] taken from a wide spectrum of technical fields.

The text is particularly suitable for those students whose scholastic preparation does not meet the required level to assure success in a technical program.

The author enhances the theme of his earlier books, *Basic Technical Mathematics*, and *Basic Technical Mathematics with Calculus*, of teaching technical mathematics through illustrative examples, stated word problems and repetitive drill.

C. V. R.

Citric Acid Cycle: Control and Compartmentation. Edited by John M. Lowenstein. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xxi + 366. Price $ 17.75; Sterling Price £ 8.3.0.

The citric acid cycle was first proposed by Krebs and Johnson in 1937 to account for the terminal stages of oxidation of carbohydrate to carbon dioxide and water. This book brings together current ideas and work on the control of the citric acid cycle. It will bridge the gap between the text-book view of the cycle and current work concerning its regulation and compartmentation.

The chapters in this volume show that our understanding of the citric acid cycle is far from complete. The functional complexity of the cycle is much greater than was recognized even ten years ago. The topics under more intense investigation include the intracellular compartmentation of the enzymes and substrates of the cycle, the specific functions of intra- and extra-mitochondrial portion of the cycle, and the specific functions of multiple alternative reactions which occur in the cycle. Each chapter covers a different area of the citric acid cycle, but the emphasis throughout is on current problems.

The book under review is directed to graduate students and biochemists who wish to become acquainted with current problems in the field.

C. V. R.

Vibration and Impact. By Ralph Burton. (Dover Publications, Inc., 180, Varick Street, New York), 1969. Pp. x + 310. Price $ 2.75.

This text, designed for senior and introductory graduate courses, is a broad introduction to the subject. It will serve as a stepping stone between introductory courses and the more advanced field of engineering analysis. The manner of presentation reflects the author's view that an understanding of basic principles of vibrations (and oscillatory phenomena in general) is needed by engineering students, regardless of what their special interests may be.

The author draws upon a gradual sequence of physical concepts in his presentation so that no mathematics beyond the calculus is needed to follow relatively advanced topics. Following the introduction (the vibrating string, harmonics, waves, the role of vibration analysis in design, and other topics) are chapters on free vibration, vibrating systems commonly found in machinery, damping, steady forced vibration, impact, non-linear vibration, measurement instruments and analogues, systems with two degrees of freedom, numerical computation of natural frequencies for systems with many degrees of freedom, waves, vibrating beams, analysis of control systems, and fatigue. Such topics as transient phenomena, self-excited vibration and control systems are included.

A large number of worked and unworked problems are distributed throughout the text, ranging from simple applications of theory to

plants effectively leading to better nodulation and crop yield.

Div. of Microbiology, Indian Agricultural Research Institute,
New Delhi-12,
October 14, 1969.

V. Iswaran.
W. V. B. Sundara Rao.
K. S. Jauhri.

---

1. Bergersen, F. J., Brockwell, J. and Thompson, J. A. *Jour. Aust. Inst. Agri. Sci.*, 1958, **24,** 158.
2. Brockwell, J. and Whalley, R. D. B., *Aust. J. Sci.*, 1962, **24,** 458.
3. —. *Aust. J. Agri. Res.*, 1962, **13,** 638.
4. Cass Smith, W. P. and Goss, O.M., *J. Agri. Western Aust.*, Ser. 3, 1958, **7,** 119.
5. Dovereiner, J., Arruda, N. B. D. and Pentcado, A., de, F., *Proc. 9th Int. Grasslands Congr.*, 1966, **3,** 1153.
6. Hastings, A., *J. Agric.*, 1962, **104,** 330.
7. —, *New Zealand Fmr.*, 1962 A, **83,** 20.
8. —, *New Zealand J. Agric.*, 1963, **106,** 463.
9. —, and Drake, A. D., *Ibid.*, 1960, **101,** 619.
10. Iswaran, V., Sundara Rao, W. V. B., Magu, S. P. and Jauhri, K. S., *Curr. Sci.*, 1969, **38** (19), 468.
11. Loneragan, J. F., Meyer, D., Fawcett, R. G. and Anderson, A, J., *J. Aust. Inst. Agric. Sci.*, 1955, **21,** 264.
12. Murguia, J. L. and Date, R A., *Proc. 9th Intern. Glassland Congr. Brazil*, 1965, **1** (2), 279.

GENETICS OF VEINAL NECROSIS IN POTATO

Parental lines obtained from Scottish Society for Research in Plant Breeding (through Dr. W. Black) have been under study at the Central Potato Research Institute, Simla, for the last few years. These lines have been observed to show veinal necrosis under glass-house conditions regularly. These symptoms have also been observed and reported from the Netherlands in the Scottish material by Thijn.[1] He has reported the veinal necrosis to be a heritable symptom controlled probably by many genetic factors showing a complex inheritance. The plant population showing veinal necrosis reported here, was tested for the possibility of virus Y and was found to be free of this virus infection.

In order to determine the inheritance of this character. two crosses were made among four of the lines, and one of the selections from an earlier cross between the lines was also selfed. The cross and the self seeds were germinated in petri dishes and the seedlings transplanted in pots with sterilized soil and grown under glass-house conditions. Beginning from the two or three leaf stage upto full maturity, the plants were observed for veinal necrosis and the segregations for the character recorded. The data along with the χ^2 values for the observed ratios are given in Table I.

Table I

Sr. No.	Crosses	Observed frequency		Total no. of plants	Expected ratio	χ^2 values
		Without veinal necrosis	With veinal necrosis			
1	CP 1516 × CP 1539	303	24	327	15 : 1	0·662
2	CP 1633 × CP 1537	427	23	450	15 : 1	0·996
3	Self progeny of a selection F_1-187 (from the crosses CP 1503 × CP 1499)	650	210	860	3 : 1	0·155

χ^2 df_1 at $0·05 = 3·841$.

The crosses 1 and 2 give a clear indication of the presence of two independent recessive factors, whereas the selfed progeny of a selection (F_1-187) from the cross CP 1503 × CP 1499 showed the segregation for one recessive factor, for the expression of veinal necrosis. To establish whether these factors are common among the parents used, crosses in all the possible combinations using only the fertile lines as the male parents have been attempted and the detailed information will be published later.

The parental lines were derived from crosses between *S. tuberosum* and *demissum* and *phureja*, similar to the Scottish material studied by Thijn.[1] His conclusions that the factors involved might have been derived from either *demissum* or *phureja* parents, may be possible. But this conclusion needs confirmation because no such wild blood seems to be responsible for the symptoms observed in material studied by Scholz *et al.*[2]

We are thankful to Mr. Lallan Giri for testing the plants biologically for virus Y.

Central Potato Research Institute,
Simla, India,
October 21, 1969.

R. T. Sharda.
M. D. Upadhya.
S. K. Anand.
Hari Kishore.

---

1. Thijn, G. A., *Meded Nea. Alg.* Keur, Dienst Landb Zaken Aardappelpootg, 1965, **22,** 58.
2. Scholz, Von, M., Menil, G. and Schreiter, J., *Nachr. BL. dt. Pfl Schutzdienst*, Berl., **1964, 6,** 166.

REVIEWS AND NOTICES OF BOOKS

Introduction to Technical Mathematics. By Allyn J. Washington. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W.1, England), 1969. Pp. xii + 464. Price 79 *sh.*

This text was written to satisfy the ever-increasing need for fundamental material for technical and "pre-technical" mathematics curricula. This book introduces the subject through a review of arithmetical operations prior to introducing traditional topics in algebra, geometry, and trigonometry.

The contents of this book are: Fundamentals from Arithmetic; Measurement and Approximate Numbers; Introduction to the Slide Rule; Signed Numbers; Introduction to Algebra; Simple Equations; Introduction to Geometry; Basic Algebraic Operations; Factorising; Exponents, Roots and Radicals; Quadratic Equations; Logarithms; Graphs; Simultaneous Linear Equations; Additional Topics from Geometry; and Introduction to Trigonometry.

There are over 3,600 problem-solving exercises taken from a wide selection of technical fields.

The text is particularly suitable for those students whose scholastic preparation does not meet the required level to insure success in a technical program.

The author enhances the theme of his earlier books, *Basic Technical Mathematics*, and *Basic Technical Mathematics with Calculus*, of teaching technical mathematics through illustrative examples, stated word problems, and repetitive drill.

C. V. R.

Citric Acid Cycle—Control and Compartmentation. Edited by John M. Lowenstein. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xxi + 366. Price $ 17.75; Sterling Price £ 8-8-0.

The citric acid cycle was first proposed by Krebs and Johnson in 1937 to account for the terminal stages of oxidation of carbohydrate to carbon dioxide and water.. This book brings together current ideas and work on the control of the citric acid cycle. It will bridge the gap between the text-book view of the cycle and current work concerning its regulation and compartmentation.

The chapters in this volume show that our understanding of the citric acid cycle is far from complete. The functional complexity of the cycle is much greater than was recognized even ten years ago. The topics now under intense investigation include the intracellular compartmentation of the enzymes and substrates of the cycle, the specific functions of intra- and extra-mitochondrial portions of the cycle, and the specific functions of multiple alternative reactions which occur in the cycle. Each chapter covers a different area of the citric acid cycle, but the emphasis throughout is on current problems.

This book under review is directed to graduate students and biochemists who wish to become acquainted with current problems in the field.

C. V. R.

Vibration and Impact. By Ralph Burton. (Dover Publications, Inc., 180, Varick Street, New York), 1969. Pp. x + 310. Price $ 2.75.

This text, designed for senior and introductory graduate courses, is a broad introduction to the subject. It will serve as a stepping-stone between introductory dynamics and the more advanced fields of engineering analysis. The manner of presentation reflects the writer's view that an understanding of basic principles of vibration (and oscillatory phenomena in general) is needed by engineering students, regardless of what their special interests may be.

The author draws upon a gradual sequence of physical concepts in his presentation, so that no mathematics beyond the calculus is needed to follow relatively advanced topics. Following the introduction (the vibrating string, harmonics, waves, the role of vibration analysis on design, and other basics) are chapters on free vibration, vibrating systems commonly found in machinery, damping, steady forced vibration, impact, non-linear vibration, measurement (instruments and analogs), systems with two degrees of freedom, numerical computation of natural frequencies for systems with many degrees of freedom, waves, vibrating beams, analysis of control systems, and fatigue. Such topics as transient phenomena, self-excited vibration, and control systems are included.

A large number of worked and unworked problems are distributed throughout the text, ranging from simple applications of theory to

derivations which require constructive thought on the part of the student. These problems are directed toward the application of theory to practical situations and also to the clarification of theoretical distinctions. Further, over 150 figures illustrate the text. C. V. R.

Oxidation. By R. L. Augustine. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 368. Price $ 18.75.

It has become increasingly difficult for the practising organic chemist to be aware of all the applications of a given reaction and to select the conditions which are most suitable for each particular application. This series provides, in separate volumes, concise and critical evaluations of important reactions in organic synthesis. Each volume deals with a single operation (hydrogenation, reduction, oxidation, etc.), so that information on all aspects of the area is readily available.

This volume contains comprehensive discussions of techniques and applications of oxidation in organic synthesis. The chemistry of hydrocarbon, oxygen and nitrogen oxidations, selenium, peracid, and peroxide oxidations, and ozonization are the major topics discussed. Specific recommendations as to the most general or applicable experimental procedures are presented in bold-faced type. Mechanistic considerations are included in the discussions primarily in order to enhance the understanding of the particular reactions. This authoritative coverage of oxidation in organic synthesis provides organic chemists with information that facilitates the carrying out of complex organic syntheses, so that more time may be devoted to the attainment of final research goals.

C. V. R.

Introduction to the Chemistry of Life. *Organic Chemistry*: By H. D. Embree. Pp. 208. Price 35 *sh.* *Biochemistry*: By H. J. DeBey. Pp. 255. Price 35 *sh.* (Published by Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W. 1, England), 1969.

The two books are shorter versions of the earlier publication *Introduction to Chemistry* which includes general chemistry, and of which A. L. Williams was also co-author (see *Curr. Sci.*, 1969, 38, 99). These two separate paperbacks have been published in these forms in response to popular requests.

The books are intended for those who are interested in knowing more about life. The phenomenon of being alive is a highly complicated, but a well regulated and orderly sequence of chemical reactions, and modern science is penetrating more and more in unravelling this mystery. *Biochemistry* is a fascinating introductory book on the subject. A serious perusal of the illustrations and their legends alone will be quite rewarding. *Organic Chemistry* prepares the necessary background. The two volumes will be particularly useful to teachers of biology and health sciences. A. S. G.

Soil Biology and Biochemistry. Editor-in-Chief: E. W. Russell. (Pergamon Press, Headington Hill Hall, Oxford OX 3, oBW, England). Annual subscription: £ 12–12–0 ($ 30.00).

This new quarterly journal is intended to act as an organ of research on soil organisms, their biochemical activities and their influence on the soil environment and plant growth. The first issue, Volume I, Number 1 for April 1969, is of 104 pages and contains 11 articles and two short communications. A. S. G.

Books Received

Crystals and Their Structures. By A. P. Cracknell. (Pergamon Press, Headington Hill Hall, Oxford), 1969. Pp. ix + 231. Price Hard Cover $ 7.00 or 45 *sh.*; Flexi Cover $ 5.50 or 35 *sh.*

Soil Biology and Biochemistry (Vol. 1, No. 1—Quarterly). (Pergamon Press, Headington Hill Hall, Oxford), 1969. Pp. 104. Annual Subscription: £ 12–12–0 or $ 30.00.

Flame Emission and Atomic Absorption Spectrometry (Vol. 1: Theory). Edited by J. A. Dean, T. C. Rains. (Marcel Dekker, New York 10016), 1969. Pp. xiv + 436. Price $ 21.75.

Chemical Rockets and Flame and Explosives Technology. By R. T. Holzmann. (Marcel Dekker, 95, Madison Avenue, New York), 1969. Pp. ix + 449. Price $ 25.75.

The Evolution of Man and Society. By C. D. Darlington. (George Allen and Unwin Ltd., Ruskin House, Museum St., London), 1969. Pp. 753. Price 70 *sh.*

Solute-Solvent Interactions. Edited by J. F. Coetzee and C. D. Ritchie. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1969. Pp. xiv + 653. Price $ 29.50.

1809–70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

THE RATE-CONTROLLING DISLOCATION MECHANISM FOR PLASTIC FLOW IN POLYCRYSTALLINE MAGNESIUM

D. H. SASTRY, Y. V. R. K. PRASAD AND K. I. VASU

Materials Research Group, Department of Metallurgy, Indian Institute of Science,
Bangalore-12, India

ABSTRACT

The deformation behaviour of polycrystalline magnesium is studied with the help of differential-stress creep tests and constant-rate tensile tests. The activation parameters characterizing the rate-controlling barrier to dislocation motion have been calculated. The obstacle energy is found to be 0·5 eV. The results indicate that the same dislocation intersection mechanism is rate-controlling in polycrystals of magnesium as in single crystals.

INTRODUCTION

THE plastic deformation of metals at low temperatures is now known to be facilitated by thermal fluctuations and an understanding of the mechanical behaviour of metals is incomplete without identifying the dislocation mechanisms responsible for the flow stress. Previous investigations[1-5] on f.c.c. metals showed that the thermally activated deformation mechanism is that of intersection of glide and forest dislocations. Comparatively less information is available on the operative dislocation mechanisms in c.p.h. metals. However, intersection mechanism is reported to be rate-controlling for low temperature deformation of magnesium single crystals[6] and polycrystalline cadmium.[7]

Bishop and Hill[8] attempted to predict the plastic behaviour of polycrystalline aggregates from single crystal data by assuming that, among others, the same systems of slip and mechanism of deformation apply to the polycrystal as to the single crystal. Mitra and Dorn[9] concluded from studies on aluminium that the same dislocation mechanism is operative in both single and the polycrystals. This is probably true for the case of f.c.c. metals. Extension of this to c.p.h. metals may not seem permissible because of the limited number of slip systems. In a polycrystalline material, at least five independent deformation systems are required in each grain. Inasmuch as there is only one basal plane per grain in hexagonal metals, the other systems are supplied by glide on prismatic or pyramidal planes or by twinning. The present investigation was initiated to ascertain whether or not the same deformation mechanism as is rate-controlling in magnesium single crystals applies to polycrystalline magnesium. With this end in view, the deformation behaviour of magnesium polycrystals is studied employing differential-stress creep experiments at 87° K. and 197° K. and constant-rate tensile tests in the temperature range 87°–700° K.

EXPERIMENTAL

Polycrystal samples of magnesium (Zn $<$ 0·01%, Al 0·007%, Si 0·005%, Pb + Cu + Ca + Sn + Ni + Fe + Mn $<$ 0·006%, rest Mg) were obtained for creep and tensile tests from rolled sheet with their axes in the rolling direction. All specimens were annealed at 673° K. for 45 minutes. Creep tests were performed on samples with average grain diameters of 0·03 mm. and 0·003 mm., obtained by controlling the mechanical treatment. Specimens employed for tensile tests had an average grain diameter of 0·003 mm. Each specimen was etched before testing.

Creep testing was done with a constant-stress tensile creep unit. The creep strain was measured using an LVDT transducer, the amplified output of which is fed to a strip-chart millivolt recorder. The accuracy of the strain measurement was 10^{-5}. Tests were conducted at 87° K. and 197° K. by surrounding the sample, fixed in a cage, with liquid oxygen and solid CO_2-alcohol mixture respectively. The specimen was initially loaded in steps of about 80 kg./cm.^{2} until creep was observed on the recorder chart. Creep curves were then recorded at stress intervals of about 80 kg./cm.^{2} At each stress level, a small load ($\sim$ 8 kg./cm.^{2}) was added to record the incremental creep curve. After a certain time, the incremental load was removed to get the decremental creep curve. This procedure was repeated until the creep rate became very low. Then a major load was added and the process of stress addition and removal repeated.

Tensile tests were performed in a modified Hounsfield tensometer on 2·5 cm. gauge length specimens. Three cross-head speeds corresponding to tensile strain rates of $7 \cdot 8 \times 10^{-4}$, $1 \cdot 8 \times 10^{-4}$ and $2 \cdot 1 \times 10^{-5}$ sec^{-1} were employed in the temperature range 87° to 700° K. For tests above room temperature, thermostatically controlled (± 2° C.) silicone oil bath was used. The load on the sample was recorded by measuring the deflection of the spring beam with the help of an LVDT transducer. The stress values reported are accurate to within 0·1 kg./mm.^{2}

RESULTS

If a single thermally activated mechanism is rate controlling, the shear strain rate, $\dot{\gamma}$, is given by :

$$\dot{\gamma} = \mathrm{NA}b\,\nu \exp.\left(\frac{-\mathrm{U}}{k\mathrm{T}}\right) \tag{1}$$

where N = the number of points of contact per unit volume between glide dislocations and obstacles, A = the area slipped per successful activation event b = the Burgers vector, ν = the frequency of vibration of the dislocation segment involved in thermal activation, U = the energy to be supplied through thermal fluctuations for the dislocation to overcome the rate-controlling obstacle, k = the Boltzmann's constant and T = the absolute temperature. It is customary to accept Seeger's approximation[9] that the thermal activation energy varies with the thermal component of the flow stress, τ^*, acting on a dislocation according as :

$$\mathrm{U} = \mathrm{U}_0 - v\,\tau^* \tag{2}$$

where U_0 is the total energy required for the activation process and 'v' is commonly referred to as the activation volume. Using Equations (1) and (2), the following expressions, which assist in the identification of the deformation mechanism, can be obtained :

$$v = k\mathrm{T}\left[\frac{\delta\, ln\, \dot{\gamma}}{\delta\tau^*}\right]_{\mathrm{T}} \simeq k\mathrm{T}\left[\frac{\Delta\, ln\, \dot{\gamma}}{\Delta\tau^*}\right]_{\mathrm{T}} = \mathrm{B}k\mathrm{T} \tag{3}$$

$$\mathrm{U} = -k\left[\frac{\delta\, ln\, \dot{\gamma}}{\delta\,(\mathrm{I}/\mathrm{T})}\right]_{\tau^*} \simeq -k\left[\frac{\Delta\, ln\, \dot{\gamma}}{\Delta\,(1/\mathrm{T})}\right]_{\tau^*} \tag{4}$$

and

$$\mathrm{U} = k\mathrm{T}\, ln\left(\mathrm{NA}b\,\frac{\nu}{\dot{\gamma}}\right). \tag{5}$$

The results of the tensile tests on magnesium polycrystals are summarised in Fig. 1, in which is shown the variation of tensile flow stress, σ, with temperature for the three strain rates employed. The flow stress values for all specimens are read at 0·1% strain offset from the modulus line. The stresses are corrected for the temperature variation of shear modulus, taking the shear modulus values for magnesium from Slutsky and Garland.[10]

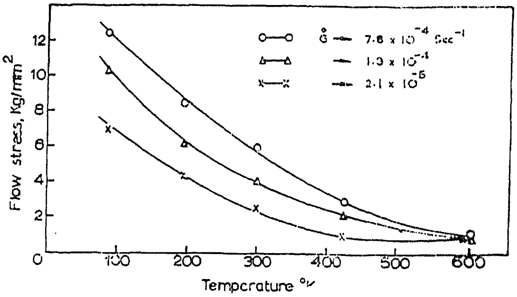


FIG. 1. Effect of temperature and strain rate on the flow stress of magnesium.

Results of the creep tests are utilised to calculate the flow parameter, B. Logarithmic creep is observed over the entire stress range (8–22 kg./mm.^{2} at 87° K. and 4–20 kg./mm.^{2} at 197° K.) studied. A typical plot of the creep rate, $\dot{\epsilon}$, obtained by graphical differentiation of the creep strain, ϵ, *vs.* log (time) plot, is shown in Fig. 2 as a function of strain. B is calculated from the change in creep rate at the instant the increment or decrement is made. The shear stress, τ, and the shear strain, γ, are calculated from the tensile counterparts by assuming that $\tau = \frac{1}{2}\sigma$ and $\gamma = 2\,\epsilon$. The dependence of activation volume obtained from Equation (3), on the effective stress, τ^*, is presented in Fig. 3. Here, the effective stress

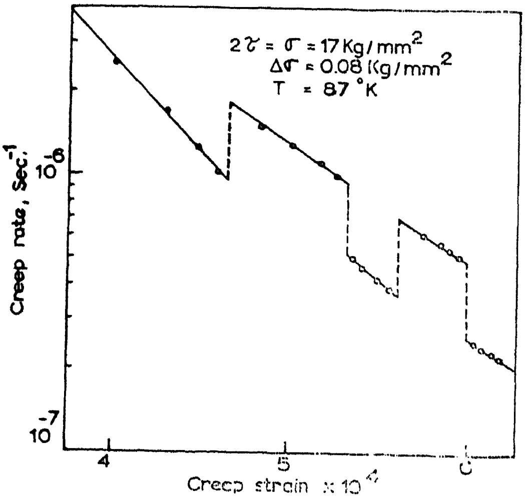


FIG. 2. Effect of stress increments and decrements on creep rate.

is taken to be the difference between the applied stress and the temperature-independent part of the flow stress. The activation volume decreases with increasing stress reaching a near constant value of 50 b^3 at 87° K. and 100 b^3 at 197° K. The Burgers vector for undissociated basal dislocations is used in this calculation. Furthermore, it can be seen from the data at 87° K. that fine-grained magnesium has a smaller activation volume at a given effective stress and the difference becomes insignificant at high stresses.

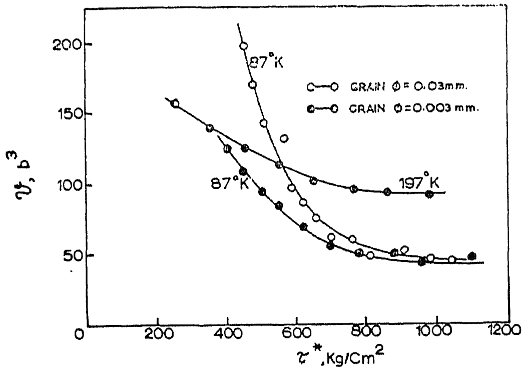


FIG. 3. Activation volume as a function of effective stress.

DISCUSSION

Conrad *et al.*[6] have demonstrated that the rate-controlling mechanism for plastic flow of magnesium single crystals at low temperatures is the intersection of dislocations. In polycrystalline aggregates, the number of operative slip systems and arrangement of dislocations are different from those in single crystals. Inasmuch as the stress to induce cross slip in single crystal is much lower than the applied stress, some cross slip may take place in favourably oriented grains. Cross slip can be thermally activated and hence the rate-controlling mechanism for the deformation of a magnesium polycrystal as a whole may be that of cross slip or mutual intersection. However, the possibility that a third dislocation mechanism could be operative should also be considered.

The rate-controlling dislocation mechanisms suggested for the plastic flow of c.p.h. metals at low temperature are: (*i*) intersection of dislocations, (*ii*) overcoming the Peierls-Nabarro (P-N) stress, (*iii*) cross slip and (*iv*) overcoming the impurity atoms. The mechanism of glide against P-N stress and cross slip require that the activation volume be small, about 10 b^3, and it be independent of temperature at a given effective stress for the P-N mechanism.[11] A value of 50 b^3 at 87° K. and 100 b^3 at 197° K. is obtained in the present investigation even at high effective stresses (Fig. 3). Furthermore, the dependency of activation volume on grain size disqualifies the P-N stress as well as the impurity atoms to be obstacles to dislocation motion in polycrystalline magnesium. In these two cases, the average distance between the obstacles, on which depends the activation volume, should not change with grain size. On the other hand, the measured activation volume is of the magnitude to be expected for the thermally activated intersection mechanism.[12]

The thermal activation energy, U, is calculated, in view of Equation (4) as function of stress from the slope of $ln\ \gamma$ *vs.* 1/T plots for a given stress from the data of Fig. 1. The assumption underlying this procedure, *viz.*, the structure remains constant for the different specimens used, is not unreasonable since the stress values are measured at constant strain and U is calculated at a given stress. Figure 4 indicates that U is sensitive function of stress as required for the intersection mechanism. By obtaining the corresponding temperature for the stress in Fig. 4, the variation of U with temperature is found to be linear (Fig. 5) as dictated by Equation (5). Figure 5 also suggests that the pre-exponential factor (P = NAb ν) is fairly independent of temperature and hence of stress. This again seems to favour the intersection mechanism over others.

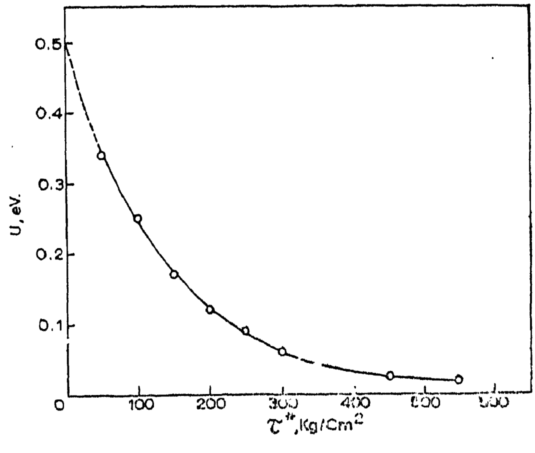


FIG. 4. Activation energy as a function of effective stress.

The dependency of activation volume on grain size gives further support to the intersection mechanism. For intersection, the activation volume is given by: $v = bld$, where 'l' is the length of the dislocation segment involved in thermal activation and 'd' is the activation distance. The increase in activation volume with increasing grain size is then a reflection of the increase in the mean free slip length, l. This is plausible inasmuch as there is a tendency in c.p.h. crystals for increasing non-basal slip with decreasing grain size. In fact, Risebrough and Teghtsoonian[13] reported decreasing amount of $\{11\bar{2}2\} < 11\bar{2}3 >$ slip in cadmium as the grain size increases. The grain size effect is not observed beyond a stress of ~ 900 kg./cm.^{2} since at such stresses a given slip system can be expected to operate with equal ease in fine-grained as well as coarse-grained specimen.

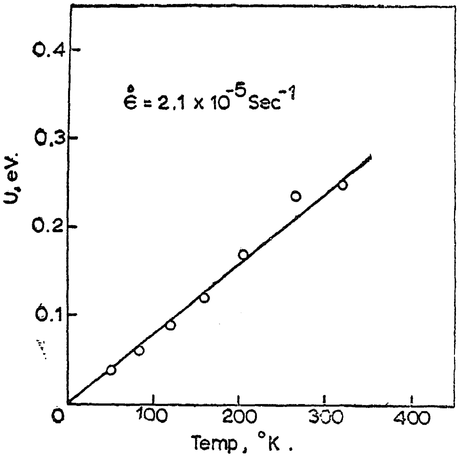


FIG. 5. Activation energy as a function of temperature.

The total intersection energy, U_0, is obtained as 0·5 eV by extrapolation of the $U - \tau^*$ curve (Fig. 4) to $\tau^* = 0$. This is only slightly higher than the theoretical estimate[14] of the jog energy in magnesium and points to a small separation of partial dislocations on basal plane. Dorn and Mitchell[15] have deduced the stacking fault width in magnesium to be $\sim 2\,b$. An estimate of forest spacing is possible since $l' = v_0/2\,b^2$, where v_0 is the activation volume at zero effective stress. This yields a forest spacing of about 7×10^{-6} cm. and a dislocation density of nearly 2×10^{10} cm.$^{-2}$ which is of reasonable magnitude. Knowing 'l', the frequency factor, P, to be expected for intersection mechanism can be calculated. Taking $N = l^{-3}$, $A = l^2$ and $\nu = b\nu_0/2\,l$ where ν_0 is the Debye frequency, P calculates to be 2×10^8 sec.$^{-1}$ which is not far from the value of 10^9 sec.$^{-1}$ obtained from the slope of Fig. 5.

The results of the current research thus show that plastic flow at low temperatures is controlled by the same thermally activated deformation mechanism in magnesium single and polycrystals. The obvious inference is that some cross slip may occur in polycrystalline magnesium but subsequent to cross slip, the dislocations move at a rate dictated by intersection.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. S. Dhawan, Director, Indian Institute of Science and Prof. A. A. Krishnan for their interest in this work and to other members of the Materials Research Group for their co-operation.

---

1. Pasinski, Z. S., *Phil. Mag.*, 1959, **4**, 393.
2. Thornton, P. R., and Hirsch, P. B., *Ibid.*, 1958, **3**, 738.
3. Mitra, S. K. snd Dorn, J. E., *Trans. Met. Soc. AIME*, 1962, **224**, 1062; 1963, **227**, 1015.
4. Mitra, S. K., Osborne, P. W. and Dorn, J. E., *Ibid.*, 1961, **221**, 1206.
5. Evans, K. R. and Flanagan, W. F., *Phil. Mag.*, 1968, **17**, 535.
6. Conrad, H., Hays, L., Schoeck, G. and Wiedersich, H., *Acta Met.*, 1961, **9**, 367.
7. Sastry, D. H., Prasad, V. V. R. K. and Vasu, K. I., *Ibid.*, 1969, **17**, 1453.
8. Bishop, J. F. W. and Hill, R., *Phil. Mag.*, 1951, **42**, 1298.
9. Seeger, A., *Dislocations and Mechanical Properties of Crystals*, John Wiley, 1957, p. 243.
10. Slutsky, L. J. and Garland, C. W., *Phys. Rev.*, 1957, **107**, 972.
11. Arsenault, R. J., *Acta Met.*, 1964, **12**, 547.
12. Conrad, H., *J. Metals*, 1964, **16**, 582.
13. Risebrough, N. R. and Teghtsoonian, E., *Cana. J. Phys.*, 1967, **54**, 591.
14. Friedel, J., *Dislocations*, Pergamon Press, New York, 1964, p. 510.
15. Dorn, J. E. and Mitchell, J. B., *High Strength Materials*, John Wiley, New York, 1965, p. 510.

SOME SALIENT FEATURES OF THE SPACE-TIME VARIATIONS OF RAINFALL OVER INDIA AND NEIGHBOURHOOD

R. ANANTHAKRISHNAN

Institute of Tropical Meteorology, Poona

SINCE Blanford (1888) published his classical monograph on the "Rainfall of India". the systematic collection, processing and publication of rainfall data by the India Meteorological Department have provided a large volume of additional material which have stimulated several studies on various facets of this subject. A recent study by Lettau and White (1964) on the "Fourier Analysis of Indian Rainfall" may be mentioned in this connection. In the present communication, attention is sought to be focused on certain aspects of the space and time variations of rainfall that have emerged from a study of the monthly and pentad rainfalls of observatory stations based on long-period normals (fifty years or more).

2. It is well known that the mean monthly rainfall of several Indian stations show two maxima and two minima. Over North India, the primary rainfall maximum occurs during the south-west monsoon season and the secondary maximum during the winter period. Over peninsular India, the situation is different. Figure 1 gives a diagrammatic representation of the space-time variation of the wettest month over India and neighbourhood. The isolines approximately demarcate the areas corresponding to the epochs of rainfall maxima. Over large areas of central and north India, July is the rainiest month. However, over a belt extending from upper Burma to the extreme north of India through the Indo-Gangetic plain, August is the month of maximum rainfall. In the interior of peninsular India, the maximum rainfall month shifts over fairly abruptly from July to September south of latitude 20° N., and to October or November at lower latitudes. The south-western coastal areas as well as lower Assam and East Pakistan experience the highest rainfall in June. Along the east coast of India, the maximum rainfall month shifts from July to October near latitude 20° N.; south of 15° N., the rainfall maximum occurs in November.

3. Figure 2 shows the space-time variations of the secondary rainfall maximum. Over most of north and central India, the secondary maximum is associated with the winter rains in January-February caused by western disturbances. To the west and north of this area, the feeble penetration of the south-west monsoon current gives rise to the secondary maximum in July-August. In the interior of peninsular India south of 20° N., the secondary maximum occurs in May, June, July or September over the different areas; along the Kerala coast, October is the month of secondary maximum.

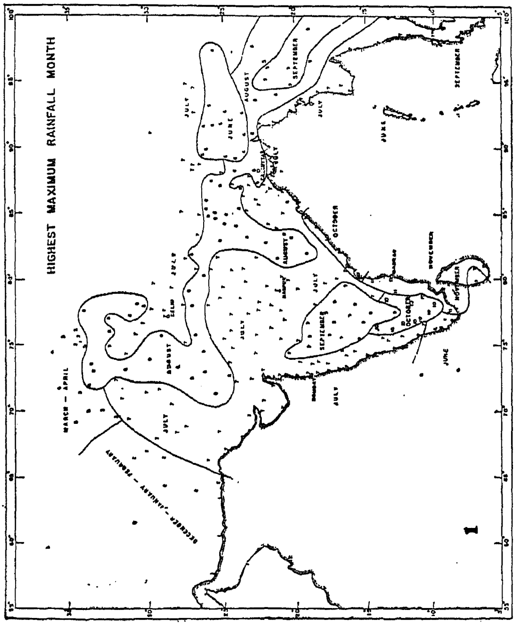
4. The spatial variation of the lowest minimum rainfall month (driest month) is shown in Fig. 3. A regular time sequence from September in the extreme west and north to February in the extreme south-eastern parts of the peninsula can be noticed. The north-eastern parts of the tip of peninsular India as well as of Ceylon are driest in the south-west monsoon months June to August. Over the western parts of central India, March-April are the driest months.

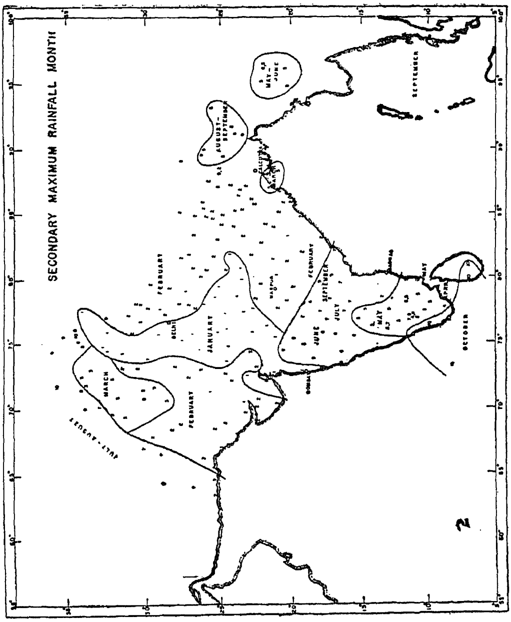
5. The manner in which the epoch of secondary minimum rainfall is geographically distributed can be seen from Fig. 4. The significant features are the temporal progression of the minimum north-westwards across north India and west Pakistan from March to June, the June-July-August minimum over the interior of peninsular India, and the September minimum over the Kerala coast. Also noteworthy is the July minimum over lower Assam, east Pakistan and upper Burma.

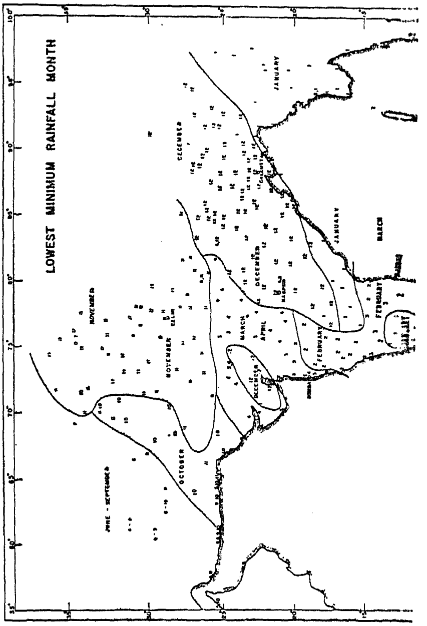
6. A deeper insight into the space-time variations of rainfall is provided by the pentad normal rainfall curves of individual stations. A few typical curves are presented in Figs. 5 to 8. Similar curves have been prepared for over 100 stations. Some of the significant facts brought out from the study of these curves are listed below.

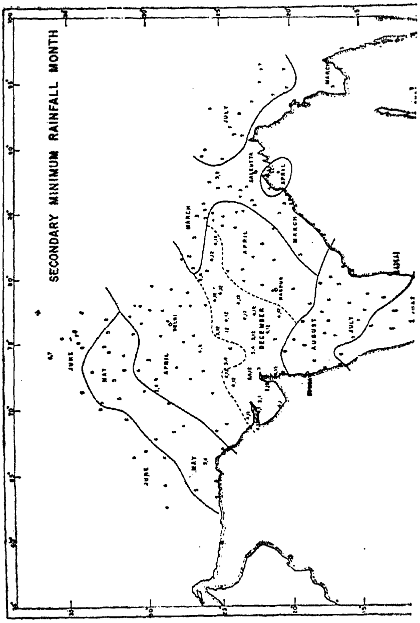
(*i*) In the first pentad of June (pentad 31) a sudden increase in the slope of the rainfall curves is noticed at several stations in the interior of the country as far north as Jodhpur, Bikaner, Delhi and Jammu.

(*ii*) As the rainfall on the west coast is steadily increasing from the beginning of June, there is a steady decrease at the interior stations over the south peninsula (Madurai, Tiruchirapalli, Kodaikanal, Bangalore, etc.). The minimum rainfall at the interior stations is reached towards the end of June (pentad 35/36), which practically corresponds to the epoch of maximum at the coastal stations.


HIGHEST MAXIMUM RAINFALL MONTH
1
MARCH – APRIL
DECEMBER – JANUARY – FEBRUARY
JULY
AUGUST
JUNE
SEPTEMBER
OCTOBER
NOVEMBER
DELHI
CALCUTTA
NAGPUR
BOMBAY
MADRAS


SECONDARY MAXIMUM RAINFALL MONTH
2
MARCH
JULY – AUGUST
FEBRUARY
JANUARY
JUNE
JULY
SEPTEMBER
MAY
OCTOBER
AUGUST – SEPTEMBER
MAY – JUNE
DELHI
CALCUTTA
NAGPUR
BOMBAY
MADRAS


LOWEST MINIMUM RAINFALL MONTH
JUNE – SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MARCH
APRIL
JANUARY
FEBRUARY
MARCH
DELHI
CALCUTTA
NAGPUR
BOMBAY
MADRAS


SECONDARY MINIMUM RAINFALL MONTH
JUNE
MAY
APRIL
MARCH
DECEMBER
AUGUST
JULY
DELHI
CALCUTTA
NAGPUR
BOMBAY
MADRAS

(*iii*) At stations such as Pamban, Cuddalore, Nagapattinam, Madras and Nellore on the east coast of the south peninsula, a steep increase in the slope of the rainfall curve sets in at or near pentad 56 (about 10 October); the peak value is attained at or about pentad 61 (first week of November).

(*iv*) After attaining peak value in July or early in August, the rainfall curves of a large number of stations over north, central and peninsular India register a decline reaching a minimum value at or near pentad 46 which is centred round 16 August. In Figs. 5 to 8, this feature can be noticed for stations such as Ratnagiri, Bombay and Surat on the west coast; at Ahmednagar, Poona, Aurangabad, Malegaon, etc., in the interior, and at Jodhpur, Bikaner and Delhi over north-west India. Several other stations such as Allahabad, Varanasi, Lucknow, Nagpur, Jabalpur, Ahmedabad, Veraval, Bhuj, etc., also show this feature. After reaching a minimum during pentad 46, the rainfall curve again registers an increase before the final decrease sets in by the middle or end of September depending upon the location of the station. The second maximum is very conspicuous at some stations and less so at others.

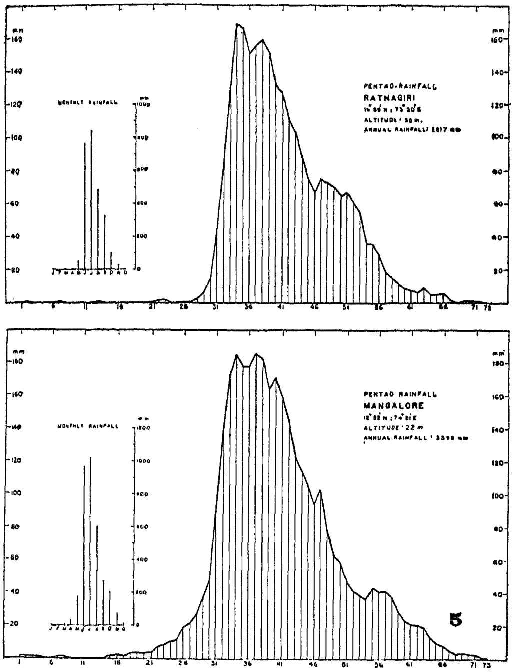


FIG. 5. Pentad rainfall: Ratnagiri, Mangalore.

7. This rainfall minimum which occurs near 16 August at a large number of stations over India is an important new feature brought out by the pentad rainfall curves. The fact that such a minimum is shown by rainfall curves of widely separated stations based on the mean data for the fifty-year period 1901 to 1950 suggests that we are concerned here with a feature

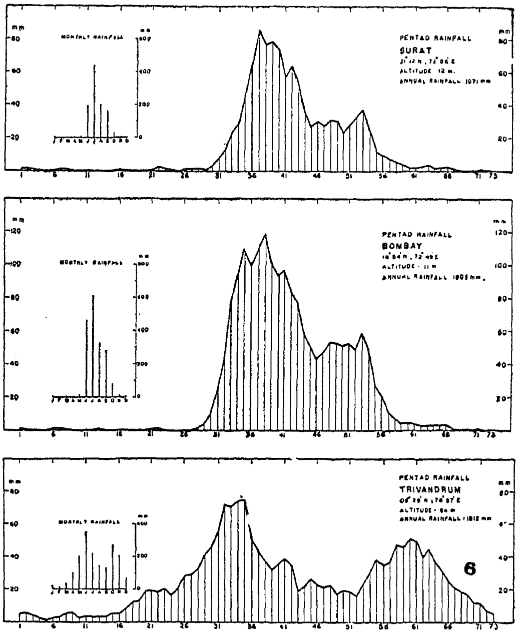


FIG. 6. Pentad rainfall: Surat, Bombay, Trivandrum.

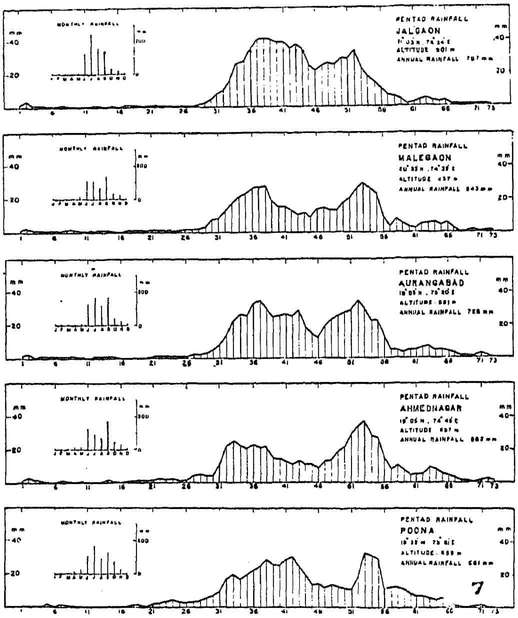


FIG. 7. Pentad rainfall: Jalgaon, Malegaon, Aurangabad, Ahmednagar, Poona.

of the monsoon circulation which is more or less repetitive from year to year. Hence, on the basis of the space and time variation of rainfall, the monsoon season can be divided into two periods, one from the beginning of June till the middle of August and the other from the middle of August till the end of September.

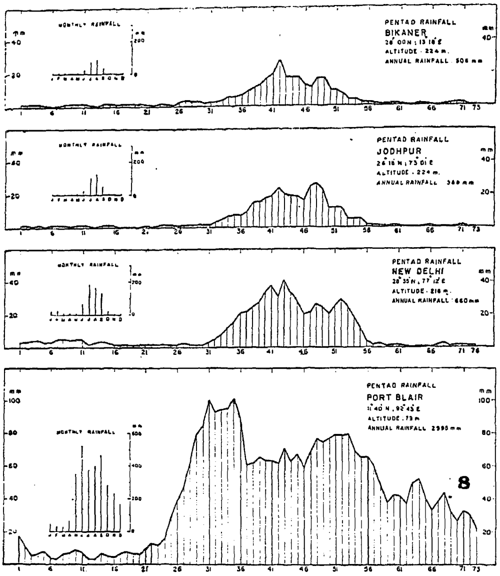


FIG. 8. Pentad rainfall: Bikaner, Jodhpur, New Delhi, Port Blair.

8. It is of interest in this connection to inquire whether there is independent evidence for any abnormality in the monsoon circulation about the middle of August. A recent study by K. Ramamurthi (1969) on 'breaks' in the south-west monsoon during July and August based on records for the eighty-year period 1888-1967 shows that the ten-day period 10-20 August is characterised by the maximum frequency of occurrence of 'breaks'; there is a rapid decline in the frequency for the succeeding ten-day period. 'Breaks' are characterised by a considerable decrease of rainfall over large areas of the country. On such occasions, the monsoon trough moves close to the foot of the Himalayas and cannot be clearly traced on the surface synoptic charts and low level wind charts. The 'break' is followed by the 'revival' of the monsoon before its gradual southward retreat sets in beginning from September.

9. On the basis of the present study it follows that the middle of August is a significant epoch in the south-west monsoon season. Climatologically this epoch appears to denote the maximum northward extension of the monsoon trough at the lower levels before its southward retreat commences.

10. The dependence of the space-time variations of tropical rainfall on the north-south seasonal migrations of the equatorial trough has been pointed out by Riehl (1954). At stations that lie in between the extreme limits reached by the trough in February and August the rainfall variations can be expected to show two maxima corresponding to the northward and southward passage of the trough. From an examination of the monthly rainfall patterns of a number of tropical stations round the globe, Riehl has concluded that a simple scheme of trough movement is not sufficient to explain all the observed patterns, although in some cases (*e.g.*, Colombo), the double rainfall peaks are quite conspicuous. It is well known that the equatorial trough has its maximum north-south amplitude of seasonal oscillation exceeding 30° of latitude over the Asian monsoon area as compared with about 5° over the western hemisphere. Hence, it is interesting to examine the space-time variations of rainfall over Indian stations in relation to trough movement. From this point of view, the rainfall minimum observed around 16 August is of particular interest. Although in addition to seasonal trough movement, rainfall is controlled by several synoptic features that vary from year to year, the effect of the trough stands out in the long period rainfall average. Preliminary study shows that the two rainfall maxima on either side of the minimum near 16 August occur during pentads 42-44 (last week of July-first week of August) and pentads 48-52 (last week of August-middle of September) at several stations in north and central India.

11. In this context, mention may be made of a study by Pachecko (1959) relating to weather at the important cities of India on Independence Day (15 August). He found that the chance of rainfall from dawn to dusk was less than 50% at several places. The present study shows that the Indian Independence Day is also a day of special meteorological significance as it coincides with the epoch of the extreme northward swing of the mean monsoon circulation and the associated minimum rainfall over large parts of the country.

12. It is generally assumed that the meteorological conditions over the Indian monsoon area are nearly identical in July and August and the meteorological parameters for these two months are often combined in several stu-

dies, [illegible] by the rainfall variations, these two months [illegible] characteristics. A critical study based on five-day means of rainfall [illegible] as well as [illegible] for understanding the major features of the [illegible] variation of the mean monsoon rainfall.

1. Blanford, H. F., "The rainfall of India," Ind. Met. Mem., 1888, 3.
2. [illegible], P. and White, E., "[illegible] of Indian rainfall," [illegible], 1964, 15, 27.
3. [illegible], L. A., "Weather in [illegible] important cities of India," Ibid., 1959, 10, 155.
4. [illegible], "Some aspects of the 'break' in the Indian south-west monsoon during July and August," [illegible], 1969, 18, 3.
5. Riehl, H., Tropical Meteorology, 1954, p. 29.

OCCURRENCE OF SODIUM, POTASSIUM, RUBIDIUM, CALCIUM AND STRONTIUM IN SOME INDIAN RIVERS*

C. SREEKUMARAN, K. T. JOSEPH AND M. PARAMESWARAN
Health Physics Division, B.A.R.C., Trombay, Bombay 85

A KNOWLEDGE of the chemical composition of river water and the stream supply of elements into the oceans is essential in understanding the [illegible] cycle. Moreover it has significance in the study of the suitability of water for [illegible] consumption, irrigation and industry. Though the mineral content of [illegible] water has been studied extensively,[1] there [illegible] the chemical [illegible] and the [illegible] of elements [illegible] these rivers. The present [illegible] sodium, potassium, rubidium [illegible] calcium and strontium content of [illegible] Indian rivers and [illegible] the import of these elements [illegible] through these rivers.

Water [illegible] from the mid-stream [illegible] locations of sampling [illegible] Table I. All samples were filtered through Millipore filters prior to analysis.

Atomic absorption spectrophotometry was employed for the estimation of all elements. Potassium and calcium were estimated directly while twenty-fold dilution was necessary for the determination of sodium and magnesium. For the estimation of rubidium and strontium 200 ml of water were evaporated to near dryness with 5 ml of concentrated nitric acid. The residue was taken up in distilled water, any undissolved matter remaining was further treated with a 1:1 mixture of hydrofluoric and perchloric acids, evaporated to dryness and leached with a few ml of 1:100 nitric acid. The solutions were combined, filtered and made up to 25 ml. Rubidium and strontium were estimated in this solution. The results of these analyses and the locations and dates of collection of the samples are given in Table I.

The sodium, potassium, magnesium and calcium values reported here are similar to those observed by Deb and Chadha for major Indian rivers as reported by [illegible] et al.[2] When compared to the world mean, sodium and magnesium values are significantly higher, calcium content is nearly the same while potassium values are lower. Both rubidium and strontium content is higher than those reported for major rivers from other parts of

TABLE I

Analyses of water from some Indian rivers

River		Location of sampling	Date of sampling	Na ppm	K ppm	Rb ppb	Mg ppm	Ca ppm	Sr ppb
Ganges	..	Allahabad	Nov., 1968	17·0	1·9	4	14·1	26·7	180
,,	..	[illegible]	Jan., 1968	20·0	2·0	7	13·0	24·7	220
,,	..	Patna	,,	29·0	1·7	3	14·6	26·0	400
,,	..	Calcutta ([illegible])	,,	16·6	1·6	3	13·8	20·0	140
Cauvery	..	[illegible]	Dec., 1967	13·0	1·0	2	8·2	11·5	150
,,	..	,,	Oct., 1967	21·4	2·1	2	11·0	17·2	140
Krishna	..	Vijayawada	,,	21·0	0·8	4	4·8	11·7	90
Godavari	..	Rajamundri	,,	17·4	0·8	4	7·2	11·5	[illegible]
Sabarmati	..	Ahmedabad	D[illegible], 1968	65·0	1·7	8	18·2	9·5	150
Mutha	..	Khadakwasla	D[illegible], 1967	10·0	0·3	3	2·4	4·0	80
Mean	..			23·0	1·4	4	10·7	16·2	173
World Mean	..			6·3†	2·2†	1·5‡	4·1†	15·0†	60‡

---

* Contribution to BARC/IAEA Research Agreement No. 155/R5/CF.

† Values taken from Livingstone.[3] ‡ Median values for North American rivers, taken from Durum and Hafty.[4]

of the monsoon circulation which is more or less repetitive from year to year. Hence, on the basis of the space and time variation of rainfall, the monsoon season can be divided into two periods, one from the beginning of June till the middle of August and the other from the middle of August till the end of September.

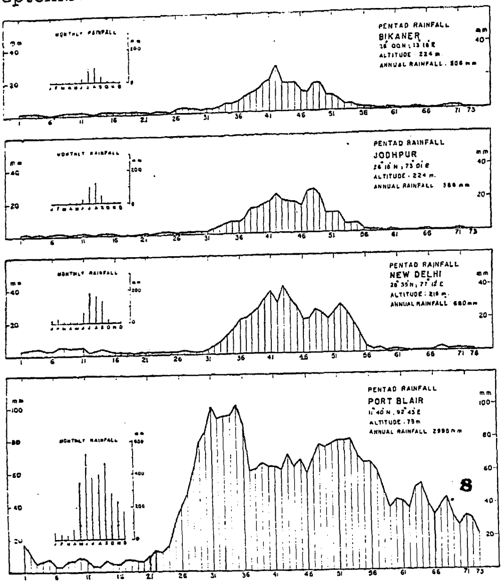


FIG. 8. Pentad rainfall : Bikaner, Jodhpur, New Delhi, Port Blair.

8. It is of interest in this connection to inquire whether there is independent evidence for any abnormality in the monsoon circulation about the middle of August. A recent study by K. Ramamurthi (1969) on 'breaks' in the south-west monsoon during July and August based on records for the eighty-year period 1888-1967 shows that the ten-day period 10-20 August is characterised by the maximum frequency of occurrence of 'breaks'; there is a rapid decline in the frequency for the succeeding ten-day period. 'Breaks' are characterised by a considerable decrease of rainfall over large areas of the country. On such occasions, the monsoon trough moves close to the foot of the Himalayas and cannot be clearly traced on the surface synoptic charts and low level wind charts. The 'break' is followed by the 'revival' of the monsoon before its gradual southward retreat sets in beginning from September.

9. On the basis of the present study it follows that the middle of August is a significant epoch in the south-west monsoon season. Climatologically this epoch appears to denote the maximum northward extension of the monsoon trough at the lower levels before its southward retreat commences.

10. The dependence of the space-time variations of tropical rainfall on the north-south seasonal migrations of the equatorial trough has been pointed out by Riehl (1954). At stations that lie in between the extreme limits reached by the trough in February and August the rainfall variations can be expected to show two maxima corresponding to the northward and southward passage of the trough. From an examination of the monthly rainfall patterns of a number of tropical stations round the globe, Riehl has concluded that a simple scheme of trough movement is not sufficient to explain all the observed patterns, although in some cases (*e.g.*, Colombo), the double rainfall peaks are quite conspicuous. It is well known that the equatorial trough has its maximum north-south amplitude of seasonal oscillation exceeding 30° of latitude over the Asian monsoon area as compared with about 5° over the western hemisphere. Hence, it is interesting to examine the space-time variations of rainfall over Indian stations in relation to trough movement. From this point of view, the rainfall minimum observed around 16 August is of particular interest. Although in addition to seasonal trough movement, rainfall is controlled by several synoptic features that vary from year to year, the effect of the trough stands out in the long period rainfall average. Preliminary study shows that the two rainfall maxima on either side of the minimum near 16 August occur during pentads 42-44 (last week of July-first week of August) and pentads 48-52 (last week of August-middle of September) at several stations in north and central India.

11. In this context, mention may be made of a study by Pachecko (1959) relating to weather at the important cities of India on Independence Day (15 August). He found that the chance of rainfall from dawn to dusk was less than 50% at several places. The present study shows that the Indian Independence Day is also a day of special meteorological significance as it coincides with the epoch of the extreme northward swing of the mean monsoon circulation and the associated minimum rainfall over large parts of the country.

12. It is generally assumed that the meteorological conditions over the Indian monsoon area are nearly identical in July and August and the meteorological parameters for these two months are often combined in several stu-

[illegible] by the rainfall variations, these [illegible] A [illegible] based on the daily means of [illegible] as well as [illegible] for [illegible] of the [illegible] rainfall.

1. Blanford, H. F., "The rainfall of India," Ind. Met. Mem., 1886, 3.
2. [illegible] and [illegible], "[illegible] Indian rainfall," [illegible], 1964, 15, 27.
3. [illegible], L. A., "Weather [illegible] at important [illegible] of India," [illegible], 1959, 10, 155.
4. [illegible], "Some aspects of the 'break' in the Indian south-west monsoon during July and August," [illegible], 1969, 18, 3.
5. Riehl, H., Tropical Meteorology, 1954, p. 59.

OCCURRENCE OF SODIUM, POTASSIUM, RUBIDIUM, CALCIUM AND STRONTIUM IN SOME INDIAN RIVERS*

C. SREEKUMARAN, K. T. JOSEPH AND M. PARAMESWARAN
Health Physics Division, B.A.R.C., Trombay, Bombay-85

A KNOWLEDGE of the chemical composition [illegible] the stream supply of elements to the oceans is essential in understanding the geochemical cycle. Moreover it has significance in the study of the suitability of water for [illegible] irrigation and industries. [illegible] mineral content of [illegible] waters has been studied extensively, [illegible] and strontium [illegible] Indian [illegible]

Water samples were collected from the [illegible] Table I [illegible] samples were filtered through Millipore filters prior to analysis.

Atomic absorption spectrophotometry was employed for the estimation of all elements. Potassium and calcium were estimated directly while twenty fold dilution was necessary for the determination of sodium and magnesium. For the estimation of rubidium and strontium 200 ml of water were evaporated to near dryness with [illegible] ml of concentrated nitric acid. The residue was taken up in distilled water, any undissolved matter remaining was further treated with a 1 : 1 mixture of hydrofluoric and perchloric acids, evaporated to dryness and leached with a few ml of 1 : 100 nitric acid. The solutions were combined, filtered and made up to 25 ml. Rubidium and strontium were estimated in this solution. The results of these analyses and the locations and dates of collection of the samples are given in Table I.

The sodium, potassium, magnesium and calcium values reported here are similar to those observed by Deb and Chadha for some Indian rivers as reported by [illegible] et al. When compared to the world mean, sodium and magnesium values are significantly higher, calcium content is nearly the same while potassium values are lower. Both rubidium and strontium content is higher than those reported for major rivers from other parts of

TABLE I

Analyses of water from some Indian rivers

River		Location of sampling	Date of sampling	Na ppm	K ppm	Rb ppb	Mg ppm	Ca ppm	Sr ppb
Ganges	..	Allahabad	[illegible], 1968	17·0	1·9	4	11·4	26·7	180
,,	..	[illegible]	Jan., 1968	20·0	2·0	7	13·0	24·7	220
,,	..	Patna	,,	29·0	1·7	3	14·6	26·0	460
,,	..	Calcutta [illegible]	,,	16·8	1·6	3	13·8	20·0	140
Cauvery	..	[illegible]	Dec. 1967	13·0	1·0	2	8·2	11·5	150
,,	..	,,	Oct. 1967	21·4	2·1	2	11·0	17·2	140
Krishna	..	Vijayawada	,,	21·0	0·8	4	4·8	11·7	90
Godavari	..	Rajahmundry	,,	17·4	0·8	4	7·2	11·5	90
Sabarmati	..	[illegible]	[illegible] 1968	65·0	1·7	8	18·2	9·5	150
[illegible]	..	[illegible]	[illegible] 1967	10·0	0·3	3	2·4	4·0	80
Mean	..			23·0	1·4	4	10·7	16·2	173
World Mean	..			6·3†	2·3†	1·5‡	4·1†	15·0†	60‡

---

* Contribution to BARC/IAEA Research Agreement No. 155/R5/CF.

† Values taken from Livingstone.[3] ‡ Median values for North American rivers, taken from Durum and Haffty.[4]

of the monsoon circulation which is more or less repetitive from year to year. Hence, on the basis of the space and time variation of rainfall, the monsoon season can be divided into two periods, one from the beginning of June till the middle of August and the other from the middle of August till the end of September.

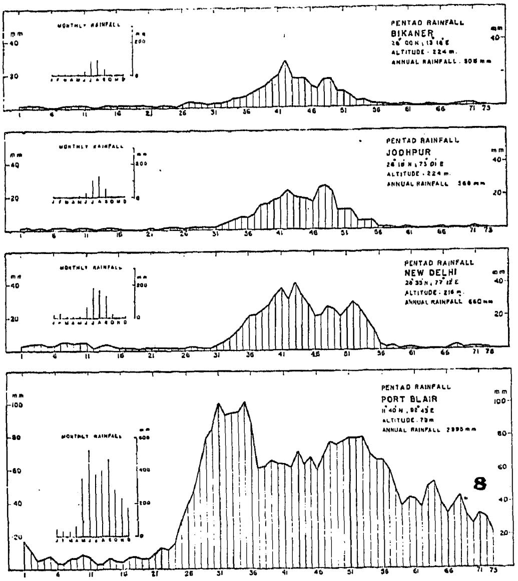


FIG. 8. Pentad rainfall : Bikaner, Jodhpur, New Delhi, Port Blair.

8. It is of interest in this connection to inquire whether there is independent evidence for any abnormality in the monsoon circulation about the middle of August. A recent study by K. Ramamurthi (1969) on 'breaks' in the south-west monsoon during July and August based on records for the eighty-year period 1888-1967 shows that the ten-day period 10-20 August is characterised by the maximum frequency of occurrence of 'breaks' ; there is a rapid decline in the frequency for the succeeding ten-day period. 'Breaks' are characterised by a considerable decrease of rainfall over large areas of the country. On such occasions, the monsoon trough moves close to the foot of the Himalayas and cannot be clearly traced on the surface synoptic charts and low level wind charts. The 'break' is followed by the 'revival' of the monsoon before its gradual southward retreat sets in beginning from September.

9. On the basis of the present study it follows that the middle of August is a significant epoch in the south-west monsoon season. Climatologically this epoch appears to denote the maximum northward extension of the monsoon trough at the lower levels before its southward retreat commences.

10. The dependence of the space-time variations of tropical rainfall on the north-south seasonal migrations of the equatorial trough has been pointed out by Riehl (1954). At stations that lie in between the extreme limits reached by the trough in February and August the rainfall variations can be expected to show two maxima corresponding to the northward and southward passage of the trough. From an examination of the monthly rainfall patterns of a number of tropical stations round the globe, Riehl has concluded that a simple scheme of trough movement is not sufficient to explain all the observed patterns, although in some cases (*e.g.*, Colombo), the double rainfall peaks are quite conspicuous. It is well known that the equatorial trough has its maximum north-south amplitude of seasonal oscillation exceeding 30° of latitude over the Asian monsoon area as compared with about 5° over the western hemisphere. Hence, it is interesting to examine the space-time variations of rainfall over Indian stations in relation to trough movement. From this point of view, the rainfall minimum observed around 16 August is of particular interest. Although in addition to seasonal trough movement, rainfall is controlled by several synoptic features that vary from year to year, the effect of the trough stands out in the long period rainfall average. Preliminary study shows that the two rainfall maxima on either side of the minimum near 16 August occur during pentads 42-44 (last week of July-first week of August) and pentads 48-52 (last week of August-middle of September) at several stations in north and central India.

11. In this context, mention may be made of a study by Pachecko (1959) relating to weather at the important cities of India on Independence Day (15 August). He found that the chance of rainfall from dawn to dusk was less than 50% at several places. The present study shows that the Indian Independence Day is also a day of special meteorological significance as it coincides with the epoch of the extreme northward swing of the mean monsoon circulation and the associated minimum rainfall over large parts of the country.

12. It is generally assumed that the meteorological conditions over the Indian monsoon area are nearly identical in July and August and the meteorological parameters for these two months are often combined in several stu-

dies. Judged by the rainfall variations, these two months have different characteristics. A critical study based on five-day means of surface and upper air parameters as well as synoptic-climatological studies are needed for understanding the major features of the space-time variations of the mean monsoon rainfall.

1. Blanford, H. F., "The rainfall of India," *Ind. Met. Mem.*, 1888, 3.
2. Lettau, K. and White, F., "Fourier analysis of Indian rainfall," *Ind. J. Met. and Geophys.*, 1964, **15**, 27.
3. Pachecko, J. A., "Weather on independence day at important cities of India," *Ibid.*, 1959, **10**, 155.
4. Ramamurthi K., "Some aspects of the 'Break' in the Indian south-west monsoon in July and August," *IMD FMU Rep. No IV*, 1969, **18**, 3.
5. Riehl, H., *Tropical Meteorology*, 1954, p. 79.

OCCURRENCE OF SODIUM, POTASSIUM, RUBIDIUM, CALCIUM AND STRONTIUM IN SOME INDIAN RIVERS*

C. SREEKUMARAN, K. T. JOSEPH AND M. PARAMESWARAN
Health Physics Division, B.A.R.C., Trombay, Bombay-85

A KNOWLEDGE of the chemical composition of river-water and the stream supply of elements into the oceans is essential in understanding the geochemical cycle. Moreover it has significance in the study of the suitability of waters for human consumption, irrigation and industry. Though the mineral content of drinking water supplies (mainly lake and well-waters) has been studied extensively,[1,2] there is little data available on the chemical composition of major Indian rivers and the supply of elements into the sea by these rivers.[3] The present paper reports the sodium, potassium, rubidium, magnesium, calcium and strontium content of waters from some major Indian rivers and an estimate of the input of these elements into the oceans through these rivers.

Water samples were collected from the mid-stream regions of the rivers (for locations of samples *see* Table I). All samples were filtered through Millipore filters prior to analysis.

Atomic absorption spectrophotometry was employed for the estimation of all elements. Potassium and calcium were estimated directly while twenty-fold dilution was necessary for the determination of sodium and magnesium. For the estimation of rubidium and strontium 200 ml. of water were evaporated to near dryness with 5 ml. of concentrated nitric acid. The residue was taken up in distilled water, any undissolved matter remaining was further treated with a 1 : 1 mixture of hydrofluoric and perchloric acids, evaporated to dryness and boiled with a few ml. of 1 : 100 nitric acid. The solutions were combined, filtered and made upto 25 ml. Rubidium and strontium were estimated in this solution. The results of these analyses and the locations and dates of collection of the samples are given in Table I.

The sodium, potassium, magnesium and calcium values reported here are similar to those observed by Deb and Chadha for major Indian rivers as reported by Soman *et al.*[2] When compared to the world mean, sodium and magnesium values are significantly higher, calcium content is nearly the same while potassium values are lower. Both rubidium and strontium content is higher than those reported for major rivers from other parts of

TABLE I

Analysis of water from some Indian rivers

River	Location of sampling	Date of sampling	Na ppm	K ppm	Rb ppb	Mg ppm	Ca ppm	Sr ppb
Ganges	Allahabad	Nov. 1968	17·0	1·9	4	14·4	26·7	180
,,	,, (Bamroh)	Jan. 1968	20·0	2·0	7	13·0	24·7	220
,,	Patna	,,	29·0	1·7	3	14·6	26·0	460
,,	Calcutta (Nabdeep)	,,	16·6	1·6	3	13·8	20·0	140
Cauvery	Trichy	Dec. 1967	13·0	1·0	2	8·2	11·5	180
,,	,,	Oct. 1967	21·4	2·1	2	11·0	17·2	140
Krishna	Vijayawada	,,	21·0	0·8	4	4·8	11·7	90
Godavari	Rajamundri	,,	17·4	0·8	4	7·2	11·5	90
Sabarmati	Ahmedabad	Dec. 1968	65·0	1·7	8	18·2	9·5	150
Mutha	Khadakwasla	Dec. 1967	10·0	0·3	3	2·4	4·0	80
Mean			23·0	1·4	4	10·7	16·2	173
World Mean			6·3†	2·3†	1·5‡	4·1†	15·0†	60‡

---

* Contribution to BARC/IAEA Research Agreement No. 155/R5/CF.

† Values taken from Livingstone.[8] ‡ Median values for North American rivers, taken from Durum and Hafty.[4]

the world.[4–6] These rivers have moderately high total dissolved solids[7] relative to the world mean.[3]

Among the rivers examined here, the two North Indian rivers, Ganges and Sabarmati, show higher values for all elements studied. Of the three South Indian rivers, Krishna and Godavari show a striking similarity in their mineral content. The concentrations of sodium, potassium, magnesium, calcium and strontium in Cauvery lie between those found in Ganges and Sabarmati on one hand and Krishna and Godavari on the other. The river Mutha has the lowest values for all elements studied. Similar observations have been made by Bhat and Krishnaswamy[7] in their work on uranium and radium isotopes in Indian rivers. Their data on the total dissolved solids in these rivers also show a similar trend. These variations have been attributed to the geological differences in the river beds and the degree of weathering of the terrains through which these rivers flow.

Sodium to potassium, sodium to rubidium, potassium to rubidium, calcium to magnesium and strontium to calcium ratios in river-water, sea-water and crustal rocks are given in Table II. Sodium to potassium ratio in Krishna, Godavari, Sabarmati and Mutha is significantly higher than that found in other rivers examined here. These rivers have lower potassium to rubidium ratios. Sodium to rubidium ratios observed in this study are higher than those reported by Yamagata and Borovic-Ramanova[3] while the potassium to rubidium ratios are lower. Strontium to calcium ratio varies from 7 to 20 with a mean value of 9·8. These values are higher than those found in major North American rivers.[3] In river Mutha the strontium to calcium ratio is same as that in sea-water. Calcium to magnesium ratio found in Indian rivers are lower than those observed in other major rivers of the world and is nearly the same as that found in crustal rocks.

TABLE II

Ratios of elements in river-water, sea-water and crustal rocks

Medium	Na/K	Na/Rb	K/Rb	Ca/Mg	Sr/Ca ×1000
Rivers :					
Ganges (Allahabad)	9	4250	475	1·9	6·7
,, (Bamroh) ..	10	2855	286	1·9	8·9
,, (Patna) ..	17	9666	566	1·08	18
,, (Calcutta) ..	10	5533	533	1·5	7·0
Cauvery (Trichy) ..	10	10700	1050	1·6	8·1
,, ..	13	6500	500	1·4	15·6
Krishna (Vijayawada)	26	5250	200	2·4	7·7
Godavari (Rajamundry)	22	4350	200	1·6	7·8
Sabarmati (Ahmedabad)	38	8125	212	0·5	15·7
Mutha (Khadakwasla)	33	3333	100	1·7	20·0
Mean for Indian rivers	19·8	6056	412	1·6	9·8
World mean* ..	2·8	4200	1553	3·7	4·0
Sea-water† ..	28	87500	3170	0·34	20
Crustal rocks‡ ..	1·07	233	216	1·7	12·5

* Values from Livingstone.[3] † From Riley and Skirrow.[8] ‡ From Mason.[9]

Table III lists the estimated amounts of sodium, potassium, rubidium, magnesium, calcium and strontium transported to the oceans in the dissolved state by Ganges, Krishna and Godavari.

TABLE III

Transport of elements into the oceans by three Indian rivers

River	Average discharge 10^{10} m^3 per year	Amount transported in 10^3 tonnes per year					
		Na	K	Rb	Mg	Ca	Sr
Ganges	36·68*	6092	587	1·10	5078	7336	51·35
Krishna	5·42†	1138	43	0·21	260	634	4·88
Godavari	10·01†	1742	80	0·40	721	1151	9·01

* From Holeman.[10] † From *International Hydrological Decade Newsletter.*[11]

We wish to thank Shri S. Krishnaswami of Tata Institute of Fundamental Research for providing us with the river-water samples for this study. We are grateful to Dr. A. K. Ganguly, Head, Health Physics Division and Dr. R. Viswanathan for their interest and guidance throughout this work.

---

1. Soman, S. D., Panday, V. K. and Joseph, K. T., *Bhabha Atom. Res. Centre Rep. A.E.E.T./H.P., Survey-120*, 1966.
2. —, —, — and Raut, S. J., *Bhabha Atom. Res. Centre Rep. B.A.R.C./H.P./Survey–120–a*, 1967.
3. Livingstone, D. A., *Geol. Survey Prof. Paper 444–G*, 1963.
4. Durum, W. H. and Hafty, J., *Geochim. et Cosmochim. Acta*, 1963, **27**, 1.
5. Kharkar, D. P., Turekian, K. K. and Bertine, K. K., *Ibid.*, 1968, **32**, 285.
6. Sreekumaran, C., Pillai, K. C. and Folsom, T. R., *Ibid.*, 1968, **32**, 1229.
7. Bhat, S. G. and Krishnaswamy, S., *Proc. Indian Acad. Sci.*, 1969, **70 A**, 1.
8. Riley, J. P. and Skirrow, G., *Chemical Oceanograaphy*, Vol. I, Academic Press, London, p. 164.
9. Mason, B., *Principles of Geochemistry*, John Wiley and Sons, Inc., New York, p. 44.
10. Holeman, J. N., *Water Resources Research*, 1968, **4**, 737.
11. *International Hydrological Decade Newsletter, India*, Council of Scientific and Industrial Research, New Delhi, 1968.

LETTERS TO THE EDITOR

DISPERSION RELATION FOR TRANSVERSE WAVES IN A RELATIVISTIC PLASMA

BUTI[1] and many other investigators studied longitudinal waves from the general dispersion relation.

Following Montgomery and Tidman[2] the relativistic Vlasov equation is

$$\frac{\partial f_1}{\partial t} + v \cdot \frac{\partial f_1}{\partial x} + q\,(v \times B_0)\,\frac{\partial f_1}{\partial p} + q\,[E + v \times B] - \times \frac{\partial f_0}{\partial p} = 0 \tag{1}$$

and through Maxwell's equations, the current density J is

$$J = \frac{i}{\mu_0 \omega}\left[k\,(k \cdot E) + \left(\frac{\omega^2}{c^2} - k^2\right) E\right]. \tag{2}$$

Choosing k, the wave-vector in x-z plane and the static magnetic field B_0 in z-direction, we get the components for current density from equation (1) as follows

$$\begin{bmatrix} J_1 \\ J_2 \\ J_3 \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix}. \tag{3}$$

The conductivity tensor σ cannot be dealt with as it is. We, therefore, consider k in the x-direction, *i.e.*, perpendicular to B_0. Then equation (3) reduces to

$$\begin{bmatrix} J_1 \\ J_2 \\ J_3 \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & 0 \\ \sigma_{21} & \sigma_{22} & 0 \\ 0 & 0 & \sigma_{33} \end{bmatrix} \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix} \tag{4}$$

where matrix elements are

$$\sigma_{11} = iq^2 \sum_{n=-\infty}^{\infty} \left[\int \frac{n^2 p_\perp \left(\frac{\partial f_0}{\partial p_\perp}\right)}{\Omega b^2 (n - a)} Jn^2 (b)\, dp\right]$$

$$\sigma_{12} = -\,q^2 \sum_{n=-\infty}^{\infty} \left[\int \frac{n p_\perp \left(\frac{\partial f_0}{\partial p_\perp}\right)}{\Omega b\, (n - a)} \times Jn\,(b)\, Jn'\,(b)\, dp\right]$$

$$\sigma_{21} = \sigma_{12}$$

$$\sigma_{22} = -\,iq^2 \sum_{n=-\infty}^{\infty} \left[\int \frac{p_\perp \left(\frac{df_0}{dp_\perp}\right)}{\Omega\,(n - a)} J_n{}^{12}(b)\, dp\right]$$

$$\sigma_{33} = q^2 \sum_{n=-\infty}^{\infty} \left[\int \frac{p_z \left(\frac{\partial f_0}{\partial p_z}\right)}{\Omega\,(n - a)} Jn^2 (b)\, dP\right]. \tag{5}$$

Also

$$a = \frac{\omega}{\Omega} \text{ and } b = \frac{kP_\perp}{\gamma m \Omega}.$$

From equations (2) and (4), we have obtained a dispersion relation which deals with one transverse mode and one hybrid mode.

The dispersion relation for transverse wave mode is

$$-\frac{q^2}{\epsilon_0\,(\omega^2 - c^2 k^2)} \sum_{n=-\infty}^{\infty} \int \left[(n\Omega - \omega)\, p_z \left(\frac{\partial f_0}{\partial p_z}\right) - \frac{n\Omega}{p_\perp} p_z{}^2 \left(\frac{\partial f_0}{\partial p_\perp}\right)\right] \frac{Jn^2\left(\frac{kp_\perp}{\gamma m \Omega}\right)}{(n\Omega - \omega)}\, dp = 1. \tag{6}$$

Assuming $\frac{kp_\perp}{\gamma m \Omega} \ll 1$, we expand $Jn\left(\frac{kp_\perp}{\gamma m \Omega}\right)$ in power series and neglecting higher order terms, the dispersion relation is given by

$$1 - \frac{2q^2 N}{\epsilon_0\,(\omega^2 - c^2 k^2)} \quad \frac{q^2}{\epsilon_0\,(\omega^2 - c^2 k^2)} \times \frac{k^2 \langle p_\perp{}^2\, p_z{}^2 \rangle}{\gamma^2 m^3 KT} \tag{7}$$

where

$$\langle p_\perp{}^2\, p_z{}^2 \rangle = \int \frac{f_0}{(\Omega^2 - \omega^2)\left(1 + \frac{p^2}{m^2 c^2}\right)^{\frac{1}{2}}} p_\perp{}^2\, p_z{}^2\, dp.$$

The authors are greatly indebted to Prof. P. L. Bhatnagar for encouragement and to Dr. K. C. Gupta for many useful discussions.

Department of Physics, University of Rajasthan, Jaipur-4, *October* 13, 1969.
R. M. GUPTA.
N. L. VARMA.

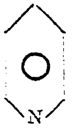
---

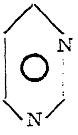
1. Buti, B., *Phys. Fluids*, 1963, **6**, 89.
2. Montgomery, D. C. and Tidman, D. A., *Plasma Kinetic Theory*, McGraw-Hill Book Co., New York, 1963.

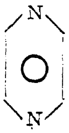
CHARGE-TRANSFER COMPLEXES OF AROMATIC AZINES WITH IODINE

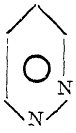
EARLY studies[1-4] on the charge-transfer interaction of iodine with pyridine and its derivatives have shown that these N-heterocyclic compounds are n-donors. Accordingly, the equilibrium constants of formation of pyridine + I_2 systems have been correlated with pK_a values of these bases.[2,3] Krishna and

Chowdhury[5] have studied the formation constants of pyrimidine and pyrazine with iodine and find that the observed charge-transfer energies, $h\nu_{CT}$, and the donor ionisation potential of these donors do not vary in the same direction. This may possibly be because, the observed ionisation potentials may correspond to π-electron ionisation, while the charge-transfer spectra are determined by the n-electrons. Mulliken[6] has recently pointed out that the charge-transfer spectrum of pyridine + I_2 can be interpreted in terms of π- and n-donor interactions occurring together. We have presently examined the spectroscopy and thermodynamics of 1 : 1 iodine complexes of pyridine (I), pyrimidine (II), pyrazine (III), pyridazine (IV) and tetramethylpyrazine, since no data were available on the energies of interaction in these systems.


I


II


III


IV

All the azines were obtained from Aldrich Chemical Co. The solvents were distilled and fractionated before use. The spectral measurements were made with Beckman DU spectrophotometer and a Cary 14R spectrophotometer. The 1 : 1 equilibrium constants, K, were determined employing the Benesi-Hildebrand equation[7] by measuring the absorbance (at the $\lambda_{max.}$ of the blue-shifted iodine band) of a series of solutions with varying donor concentrations (0·03-0·5 M) and constant iodine concentration (5×10^{-4} M). In evaluating K, Person's criteria[8] regarding donor concentration were satisfied. In the case of pyridazine, the high extinction of the blue-shifted iodine band restricted donor concentration to the range 0·004-0·02 M. The enthalpies of formation were determined by evaluating the equilibrium constants at various temperatures between 20° and 45° C. The K as well as $\Delta H°$ values have an uncertainty less than ± 10%.

The results of the present investigation are shown in Table I. Solubility considerations prevented the use of cyclohexane as solvent in the case of tetramethylpyrazine and pyridazine; the solubility of pyridazine in cyclohexane is considerably reduced in the presence of I_2.

TABLE I

Thermodynamic and spectroscopic data for the interaction of azines with iodine

Donor	Ionisation potential eV	CT band	Blue-shifted I_2 band				K, litre mole^{-1} (25°)	$-\Delta H°$, Kcal. mole^{-1}
		$\lambda_{max.}$ mμ	$\lambda_{max.}$ mμ	$\epsilon_{max.}$, litre mole^{-1} cm.$^{-1}$	$\Delta\nu_{\frac{1}{2}}$ cm.$^{-1}$	f		
Pyridine$^{(b)}$ ..	9·76	235	425	1387	4400	0·026	126	7·8
Pyridazine$^{(a)}$ ..	9·86	245	400	1724	7780	0·058	70	11·0
Pyrimidine$^{(b)}$ ..	9·91	236 and 246	430	1250	3340	0·018	16	8·0
Pyrazine$^{(b)}$ ..	10·01	242	440	1361	4320	0·025	12	5·0
2, 3, 5, 6-tetramethylpyrazine$^{(a)}$	..	..	430$^{(c)}$	1428	..	..	5·4	..
Sym-Triazine$^{(b)}$ ..	..	..	470	$^{(d)}$	..	..	2	..

$^{(a)}$ In chloroform, $^{(b)}$ In cyclohexane, $^{(c)}$ A shoulder, $^{(d)}$ Low value (< 1,000).

The charge-transfer bands in all these azine systems appear in the region of donor absorption and the λ_{CT} values could, therefore, be obtained by difference spectra. The present values of λ_{CT} in the case of pyrimidine and pyrazine agree with these reported by Krishna and Chowdhury.[5] Pyrimidine gives rise to two CT transitions corresponding to the two non-bonding molecular orbitals. The $h\nu_{CT}$ values of these azine-I_2 systems vary in the order, pyridine > pyrazine > pyridazine ≥ pyrimidine, while the ionisation potential values vary in the order pyrazine > pyrimidine > pyridazine > pyridine. If we ignore the data on pyridine, the $h\nu_{CT}$ values of the other systems roughly vary in the expected direction. It is quite possible, therefore, that both the charge-transfer spectra and ionisation potential correspond to the same orbitals. From these studies, we are, however, unable to comment on the relative importance of π- and n-donor interactions of the azines. The charge-transfer bands were broad, and we could not clearly see any evidence for the two modes of electron donation as reported by Mulliken[6] for the case of pyridine + I_2.

In Table I, the data on the blue-shifted I_2 band have been summarised; it is seen that the blue-shifts are appreciable, typical of strong charge-transfer complexes.[9,10] The intensity of the blue-shifted band is roughly the same with all the azines except with *s*-triazine which shows a very low ϵ as well as K. The K value decreases as the ionisation potential of the donor increases. The enthalpies of formation in these systems are quite large (5-11 Kcal. mole^{-1}) and show exactly the same trend as the $\lambda_{max.}$ of the blue-shifted iodine band. Apparently, the energy of the blue-shifted band provides a good measure of donor-acceptor interaction, as pointed out by Mulliken.[9,10] Among all the azines studied, pyridazine is the strongest donor.

The iodine complexes of all the diazines show evidence for I_3^- on standing. The formation of I_3^- undoubtedly results from the transformation of the outer charge-transfer complex to the inner complex[11] similar to that reported by Reid and Mulliken[1] for the pyridine + I_2 system.

The author is thankful to Dr. K. R. Bhaskar for his assistance with some of the measurements, and to Professor C. N. R. Rao of the Indian Institute of Technology, Kanpur, for suggesting the problem and guidance.

Dept. of Chemistry, P. C. Dwivedi.
Harcourt Butler Tech. Inst.,
Kanpur-2, *October* 9, 1969.

---

1. Reid, C. and Mulliken, R. S., *J. Amer. Chem. Soc.*, 1954, **76,** 3869.
2. Chaudhuri, J. N. and Basu, S., *Trans. Faraday Soc.*, 1959, **55,** 898.
3. Bhaskar, K. R. and Singh, S., *Spectrochim. Acta*, 1967, **23,** 1155.
4. Rao, C. N. R., *Ultraviolet and Visible Spectroscopy*, Butterworths, London, Second Edition, 1967.
5. Krishna, V. G. and Chowdhury, M., *J. Phys. Chem.*, 1963, **67,** 1067.
6. Mulliken, R. S., *J. Amer. Chem. Soc.*, 1969, **91,** 1237.
7. Benesi, H. A. and Hildebrand, J. H., *Ibid.*, 1949, **71,** 2703.
8. Person, W. B., *Ibid.*, 1965, **87,** 167.
9. Mulliken, R. S. and Person, W. B., *Ann. Rev. Phys. Chem.*, 1962, **13,** 107.
10. —, *J. Chim. Phys.*, 1963, p. 20.
11. Bhat, S. N. and Rao, C. N. R., *J. Amer. Chem. Soc.*, 1966, **88,** 3216.

DECOMPOSITION OF ISOPROPYL ALCOHOL ON $ZnO-Al_2O_3$ CATALYST—EFFECT OF CRYSTAL STRUCTURE ON CATALYTIC ACTIVITY

It is known that isopropyl alcohol undergoes dehydrogenation as also dehydration on zinc oxide and zinc oxide-based catalyst.[1] While the dehydrogenation has been associated with the electronic properties[2] of the surface, dehydration has been reported to be a function of the available surface and the surface acidity[3] of the catalyst. The present investigation with a co-precipitated zinc oxide - alumina catalyst has been undertaken with a view to study the effect of the crystallographic structure of the catalyst on these two simultaneous reactions. The study of this mixed oxide system was prompted by the fact that the behaviour of the individual constituents, namely, ZnO and Al_2O_3, towards the decomposition of isopropyl alcohol has been thoroughly investigated.[1] The present work also includes the investigation of the structural transformations that the mixed oxide system undergoes during thermal treatment.

The $ZnO-Al_2O_3$ (1 : 1) catalyst was prepared by co-precipitation from an appropriate solution containing a mixture of nitrates (analar grade) of zinc and aluminium by ammonium carbonate and subsequent decomposition of the carbonates. The thermal treatment of the catalyst was followed by DTA. The studies on the catalytic activity for the decomposition of isopropyl alcohol were carried out in an apparatus similar to that reported by Upreti *et al.*[4]

It will be seen from the thermogram presented in Fig. 1, that apart from the three normal endotherms corresponding to the removal of water and the decomposition of the parent precipitates, three exothermic dents around 590°, 670° and 820° C., are also obtained. These could be attributed to the step-wise formation of zinc aluminate spinel involving the steps of formation of solid solution, disordered spinel

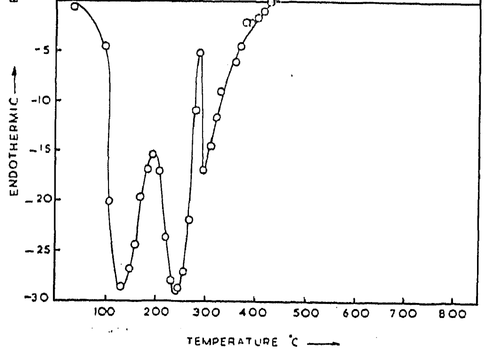


FIG. 1. D.T.A. curve for the mixed oxide of $ZnO-Al_2O_3$.

and ordered spinel structures respectively. This is in accordance with the conclusions arrived at during the investigation[5] of ZnO-Cr_2O_3 system by DTA and of ZnO-Al_2O_3 system by X-ray analysis.[6] The spinel formation, in the present case, may be due to the reaction:

$$ZnO + Al_2O_3 \rightarrow Al_2ZnO_4$$

and the exothermic region of the thermogram could be indicative of the crystallisation of the oxides together with the spinel formation. The co-precipitated catalyst, heated to 500° C. (S.A. 148 $m^2/g.$) when no spinel is formed, was investigated for the decomposition of isopropyl alcohol. Experiments were conducted in the temperature region of 335° to 410° C. employing different contact times. The extent of dehydrogenation and dehydration occurring simultaneously was evaluated by gas-chromatographic analysis of the products, namely, acetone, water and undecomposed alcohol. The initial slopes of the concentration-time curves were used in the Arrhenius plots which gave the values of 11 kcal/mole and 6·4 kcal/mole as the activation energies for the dehydrogenation and dehydration reactions respectively. These values agree well with the values for dehydrogenation on pure ZnO and dehydration on pure alumina.[7] The results would therefore indicate that the system heated to 500° C. behaves like a physical mixture of the two constituent oxides.

Decomposition studies on the system heated to 840° C. (S.A. 46 $m^2/g.$) ensuring complete spinel formation, showed decreased dehydrogenation activity while the dehydration remained apparently unaltered. However, the surface area had decreased to one-third the value obtained for the system heated to 500° C. This could be ascribed to the destruction of the fine pore structure on heating as has been borne out by an actual pore-size distribution analysis in the present instance. The results also indicate that the dehydration activity of the system has considerably increased on the basis of unit area of the catalyst. This observation is in contradiction to that of Schwab,[8] whose extensive investigations show that heat treatment of oxides reduces dehydration activity while in many cases enhancing dehydrogenation. Branson,[6] based on X-ray diffraction and inert marker studies, has conclusively proved the one way diffusion of zinc oxide into aluminium oxide resulting in a solid solution followed by the formation of spinel. In the present instance also, the results would indicate the formation of a spinel structure as formulated by Branson, namely, the formation of a zinc oxide core surrounded by alumina. Such a structure would predominantly expose alumina on the surface, effectively concealing most of ZnO, thus resulting in increased dehydration activity accompanied by loss of dehydrogenation.

X-ray diffraction studies of the mixed oxide heated to 500° C. showed only four broad ill-defined lines which could be due to the non-crystallinity of the material and the presence of lattice heterogeneity while that obtained with the sample, heated to 840° C., agreed fairly with that obtained for heated γ-Alumina thus lending support to the type of spinel structure postulated above.

In conclusion, catalytic activity studies might be useful in the elucidation of the mode of solid state reactions and structural changes occurring in mixed oxide systems.

Acknowledgement is made to the donors of the Petroleum Research Fund, administered by the American Chemical Society, for partial support of this research.

Dept. of Chemistry, B. VISWANATHAN.
Indian Inst. of Technology, V. SRINIVASAN.
Madras-36, *October* 16, 1969. M. V. C. SASTRI.

---

1. Eucken, A. and Heuer, K., *Z. Physik. Chem.*, 1950, **196**, 49.
2. Otwinowska, H., Treszczanowicz, E. and Ciborowski, S., *Actes 2eme Congr. Inter. de catalyse*, 1961, **2**, 1733.
3. Sharf, V. Z., Freidlin, L. Kh., German, E. N., Samokhvalov, G. I. and Papko, T. S., *Kinetics and Catalysis*, 1968, **9**, 784.
4. Upreti, M. C., Kuriacose, J. C. and Sastri, M. V. C., *Bull. Acad. Polon. Sci. Ser. Sci. Chim.*, 1963, **11**, 651.
5. Bhattacharya, S. K. and Ramachandran, V. S., *Proc. Natl. Inst. Sci.*, 1959, **12**, 23.
6. Branson, D. L., *J. Am. Cerac. Soc.*, 1965, **48**, 591.
7. Unpublished results from this laboratory.
8. Schwab G. M. and Schwab-Agallides, E., *J. Am. Chem. Soc.*, 1949, **71**, 1809.

CHEMICAL INVESTIGATION OF *RHODODENDRON PONTICUM* HOOK.

PLANTS belonging to the genus *Rhododendron* (fam.: Ericaceæ) are known to possess medicinal and poisonous properties.[1] The oils obtained from the flowers and leaves of *Azalea pontica* (*R. ponticum*) were recorded to be highly toxic and to possess bacteriostatic activity. The plant was shown to contain arbutin and andromedotoxin, especially in flowers and in lesser amounts in stems, leaves and roots.[2] The results obtained from a systematic chemical investigation of the leaves of this plant are described here.

The powdered leaf was successively extracted with light petrol (b.p. 60–80°), chloroform and methanol. The petrol extract, on concentration to a low volume, gave a solid (fraction 1). The mother liquor was evaporated to a residue which was saponified. The unsaponifiable matter was treated with acetone when crystals deposited (fraction 2). Further concentration of the acetone mother liquor yielded crystals (fraction 3). Fractions 1 to 3 were united and chromatographed over neutral alumina. The residue from the petrol eluate, on crystallisation from benzene-petrol, yielded substance A recorded below. The mother liquor was evaporated and the residue was crystallised from acetone yielding colourless nodules, m.p. 74–76°. The substance did not answer the usual triterpenoid colour reactions and did not form an acetate. The petrol-benzene (9 : 1, 4 : 1, 1 : 1) eluates furnished a crystalline solid which was identified as friedelin[3] (substance A): colourless needles from benzene-petrol, m.p. 250-52°, $[\alpha]_D = -30 \cdot 5°$; 2 : 4-dinitrophenylhydrazone, m.p. 298–300°. The identity was confirmed from mixed m.p. and superimposable I.R. spectra. The benzene-chloroform (49 : 1, 19 : 1, 9 : 1, 4 : 1, 1 : 1) and chloroform eluates yielded epifriedelanol[3] (substance B): colourless plates from chloroform-alcohol, m.p. 281–82°, $[\alpha]_D = +25 \cdot 1°$; benzoate, m.p. 250–52°, $[\alpha]_D = +28 \cdot 2°$. Confirmation of the identity was obtained from mixed m.ps., superimposable I.R. spectra and identical colour reactions.

The chloroform extract was concentrated, diluted with ether and the resulting solution was shaken with 5% sodium hydroxide when a precipitate separated at the interphase. This was filtered, dissolved in alcohol and decomposed with acid. Dilution and removal of the alcohol under reduced pressure gave a solid which crystallised as colourless needles from absolute alcohol (substance C): m.p. 279–82°, $[\alpha]_D = +59 \cdot 0°$ (pyridine); acetate, m.p. 281–82°, $[\alpha]_D = +72 \cdot 3°$; methylester, m.p. 110–12°, $[\alpha]_D = +53 \cdot 3°$; acetate of methylester, m.p. 243–46°, $[\alpha]_D = +68 \cdot 0°$. These properties indicated its identity with ursolic acid[3] and the identity was confirmed from mixed m.ps. The precipitate, obtained on neutralization of the alkali extract above, was treated with diazomethane and the residue was chromatographed over neutral alumina when methyl ursolate was obtained. The result was confirmed by preparation of acetylmethylursolate. The alkali-insoluble fraction was saponified and the unsaponifiable matter was treated with acetone yielding a solid deposit. This was chromatographed over neutral alumina. The petrol-benzene (19 : 1, 9 : 1, 4 : 1) eluates gave friedelin. The benzene-chloroform (49 : 1) eluate gave a substance, m.p. 176–77° (colourless plates from petrol, substance D); Liebermann-Burchard reaction: pink-violet-blue-green. The benzene-chloroform (19 : 1, 9 : 1, 4 : 1, 1 : 1) and chloroform eluates yielded a substance, m.p. 215–16° (colourless nodules from benzene-petrol, substance E); Liebermann-Burchard reaction : pink. As the yields were poor, substances D and E were not studied further.

The methanol extract was concentrated under reduced pressure to a low volume, hydrolysed with 7% sulphuric acid and extracted with ether. The residue from the ether extract. on crystallisation from dilute alcohol, gave quercetin, m.p. 302–06° (substance F). This gave identical U.V. spectrum as authentic quercetin[3]; penta-acetate, m.p. 195–97° (mixed m.p. undepressed).

All rotations were taken in chloroform except where otherwise stated.

The authors thank Prof. S. Rangaswami for his kind interest and Prof. L. R. Row for the I.R. spectra.

Dept. of Pharmacy, K. SAMBAMURTHY.
Andhra University, M. RAJENDRA BABU.
Waltair, *October* 16, 1969.

---

1. Chopra. R. N., Badhwar, R. L. and Ghosh, S., *Poisonous Plants of India*, Manager of Publications, Delhi, 1949, **1**, 613.
2. Korta, J., *Chem. Abs.*, 1954, **48**, 5445.
3. Rangaswami, S. and Sambamurthy, K , *Proc. Ind. Acad. Sci.*, 1961, **54 A**, 99.

IN-VITRO SENSITIVITY OF *VIBRIO CHOLERAE* BIOTYPE *ELTOR* TO CLIOQUINOL (ENTEROVIOFORM)

TETRACYCLINE has been proved to be valuable for the treatment of cholera[1-3] and for chemoprophylaxis of household contacts of cholera patients.[4] However, the high cost of the drug restricts its routine use in cholera-affected countries. Efforts have been made during the recent years to find out a cheaper substitute for the same. A laboratory evaluation of clioquinol (vioform) as a prophylactic agent against cholera has been reported.[5] The results of the study showed that *Vibrio choleræ* and its biotype *ElTor* were inhibited by a relatively low concentration of the drug. It was suggested that clicquinol may prove useful in the control of cholera epidemics by eliminating vibrio excretors. A similar study has been conducted by Ghosh *et al.*[6]

Present study was intended to find out the sensitivity pattern of the vibrio strains isolated from the various parts of the country against clioquinol.

Two hundred strains of *V. choleræ* biotype *ElTor* isolated from Delhi, Rajasthan, Uttar Pradesh and Madras during 1968 were included for the study. Vioform powder was kindly supplied by M/s. CIBA of India Ltd. Tube dilution method of sensitivity testing was used following the technique of Finkelstein and Raungthum.[5] The powder was suspended at 10 mg./ml. in absolute ethanol and heated to solution in water-bath. Two-fold serial dilutions were made in peptone water. One drop of 18 hours peptone water culture of the test strains was used as inoculum. Results were read after overnight incubation at 37° C. Subcultures were made on Bile salt agar media to determine the vibriocidal concentration.

Results of the study are shown in Table I.

TABLE I

Clioquinol sensitivity of V. choleræ *biotype* ElTor *minimum inhibitory concentration*

Source	No. of strain	125 μg.	62·5 μg.	31·2 μg.	15·6 μg.	7·8 μg.	3·9 μg
Delhi ..	96	..	1	15	67	11	2
Rajasthan ..	14	..	..	2	8	4	..
Uttar Pradesh (Lucknow)	58	..	..	2	18	38	..
Madras ..	32	..	1	2	13	16	..
Total ..	200	..	2	21	106	69	2

Minimum inhibitory concentration ranged from 3·9 to 62·5 mg./ml. The majority of the strains (175) were inhibited at concentration between 7·8 and 15·6 mg./ml. The vibriocidal concentrations were either the same or double as that of vibriostatic concentrations.

The results of the study suggest that the vibrio strains isolated from different parts of the country were sensitive to relatively low concentration of clioquinol. High vibriocidal activity, low cost and absence of side effects make it ideally suitable for mass chemoprophylaxis. However, the efficacy of clioquinol to eliminate vibrio excretors can be determined only after controlled field trials. The present study emphasises the need for such a field trial.

National Institute of
Communicable Diseases,
22, Alipore Road,
Delhi-6, *October* 17, 1969.

S. G. MULLICK.*
S. N. VARMA.
B. S. MISRA.
S. C. PAL.

---

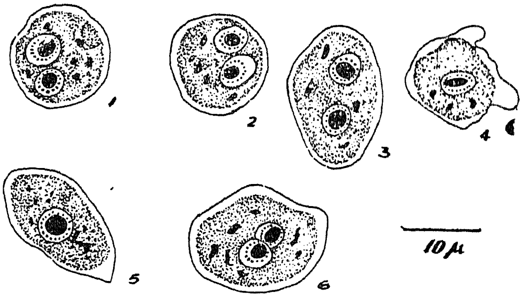
* Present address : Indian Veterinary Research Institute, Izatnagar, U.P.

1. Carpenter, C. G. J., Sack, R. B., Mondal, A. and Mitra, P. P., *J. Indian Med. Assoc.*, 1964, **43,** 309.
2. Greenough, W. B., Gordon, R. S., Rosanberg, I. S., Davies, B. I. and Benenson, A. S., *Lancet*, 1964, **1**, 355.
3. Kobari, K., Uylangco, C., Vasco, J., Takahira, Y. and Shimizee, N., *Bull. Wld. Hlth. Org.*, 1967, **37**, 751.
4. McCormack, W. M., Chowdhury, A. M., Jahangir, A. B., Fariduddin Ahmad and Moslay, W. H., *Ibid.*, 1968, **38**, 787.
5. Finkelstein, R. A. and Raungthum, J., *Ibid.*, 1968, **38**, 803.
6. Ghosh, A. K., Shrivastava, D. L. and Chaudhuri, R. N., *Ind. Jour. Med. Res.*, 1968, **56**, 979.

DIENTAMOEBA DOBELLI N. SP. FROM A LARVA OF DUNG BEETLE

THE investigation of the rectal contents of the common beetles *Oryctes rhinoceros* larvæ, from Hyderabad, revealed the heavy infection of the parasite belonging to the genus *Dientamœba* Jepps and Dobell (1917). The infection was found in two out of twenty larvæ and in all cases, the parasites were associated with other flagellates and ciliates. The present species is the first of this genus to be recorded from the Indian insects. This is the second species to be described from this genus.

The organism, in stained preparations, is round or elongated (Figs. 1, 2, 3 and 5). A clear ectoplasm is enclosing a thickly granulated endoplasm with few vacuoles. Few individuals, with a slightly blunt pseudopodium



FIGS. 1–6. Figs. 1–2. Round forms with two nuclei. Figs. 3 and 6. Elongated forms with two nuclei. Fig. 4. Amoeboid form with single nucleus and pseudopodia. Fig. 5. Elongated form with single nucleus. (All the drawings were made with the material fixed in Schaudnin's and stained with hæmatoxylin stain.)

on one side of the body, are noticed (Figs. 4 and 6). There are two nuclei in most of the individuals, with large round central or eccentric endosomes (Figs. 1-6). The endosome is a compact mass, with a ring of small chromatin granules arranged in between the nuclear membrane and the endosome. Very few individuals appear to have only one nucleus with the same shape and structure (Figs. 4 and 5). Cysts are not seen. The body measures in length (8·5–33·5 μ) 13·53 μ and width (8·5–16·0 μ) 11·96 μ while the diameter of round individuals in average is 12·59 μ. The average diameter of the nucleus is 4·53 μ and of the endosome 2·30 μ.

The only complete description available of the species of this genus is that of *Dientamœba fragilis* described by Jepps and Dobell (1917). This species is small and measures 3·5 μ to 12·0 μ in diameter. Each nucleus has a large endosome composed of granules of chromatin, loosely arranged, embedded in plastin and situated in the centre of the nucleus. Whereas the present amœba is very big in size with its large nuclei. The endosomes are situated eccentrically or in the centre. In between the nuclear membrane and the endosome there is a ring of chromatin granules.

By the comparison of the only known *Dientamœba fragilis* with the present amœba of the insect, it is clear that the latter one is a new species. Therefore, it is proposed to name it as *Dientamœba dobelli* n. sp.

I am grateful to Prof. S. S. Qadri for his guidance and to Prof. S. N. Singh for the laboratory facilities.

Department of Zoology, T. BHASKAR RAO.
Post-Graduate Centre,
Osmania University,
Warangal, A.P., *April* 4, 1968.

---

1. Jepps, M. W. and Dobell, C., *Parasitol.*, 1917, **10**, 352.
2. Dobell, C. and O'Conner, F. W., *The Intestinal Protozoa of Man*, 1921, p. 1.
3. Craige, F. C., *Jour. Parasitol.*, 1926, **13**, 137.

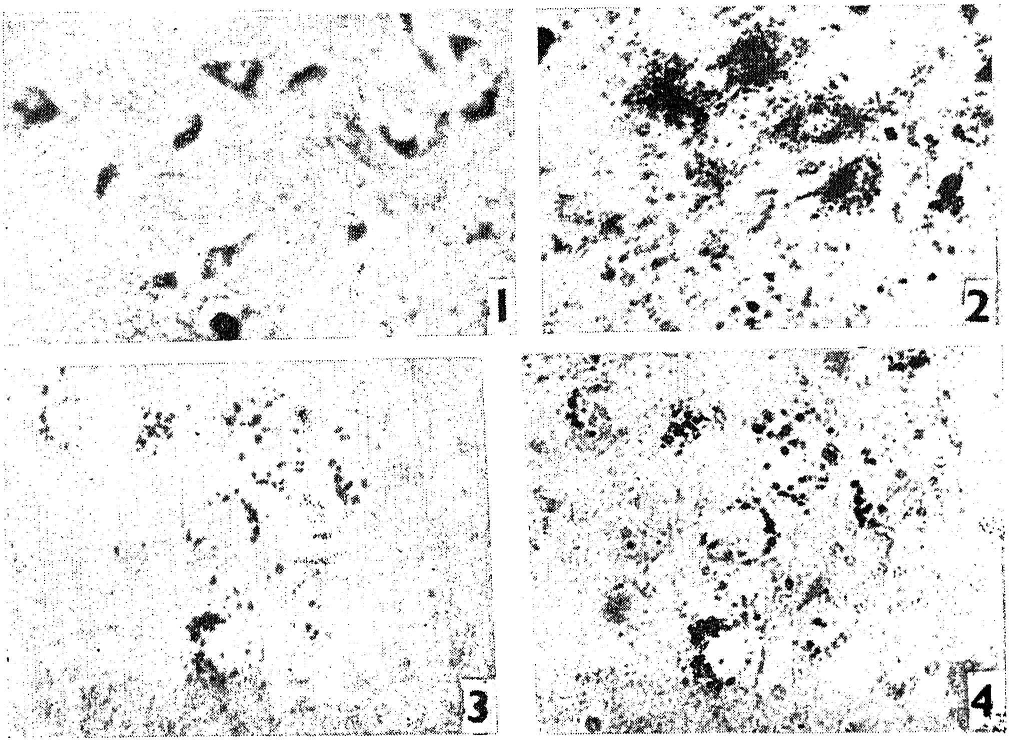
SOME COMMENTS CONCERNING HISTOCHEMICAL STAINING OF NEURONAL LIPOFUSCIN BY SILVER IMPREGNATION

OF a great variety of histochemical methods available for staining neuronal lipofuscin, silver diamminohydroxide impregnation technique as devised by Nassar *et al.*[1] is the only one which has been claimed to selectively demonstrate that a lipofuscin granule is made up of successive concentric layers which are probably chemically distinct. It was shown that the silver diamminohydroxide impregnation of potassium permanganate oxidised sections stained the outermost layer of the granule but its inner core was unstained, thus giving it an appearance of a circle, whereas the similar silver impregnation of unoxidised sections stained only the inner core of the granule, thus giving it an appearance of a solid dot having the outer layer as an unstained circular halo around. The diameter of the circle was found to be double that of the dot. It was, therefore, concluded that the silver impregnation of oxidised sections was a selective method for staining the granule's chemically distinct outer layer which was found to remain unstained with all the other methods for staining lipofuscin. These observations were limited to the study of the brain of man.

The validity of this method for demonstrating a concentric layered histochemical structure in the lipofuscin granule has never been tested by subsequent workers, and also the validity of the idea of possible occurrence of such a concentric structural orientation of chemical substances in the individual lipofuscin granules has never been put to a critical examination or review.

During our histochemical work on the avian nervous tissues, staining of the neuronal lipofuscin by this technique in the avian brain showed results contrary to those obtained by Nassar *et al.*[1] and Issidorides and Stanklin[2] in the human nervous tissues as described above. In the present work, the brain tissues of adult parrot (*Psittacula krameri*) were used. Brain tissues of rat were also used for comparison. Silver diamminohydroxide technique as given by Nassar *et al.*[1] was followed. Other methods considered relatively useful and selective for lipofuscin, *viz.*, carbol fuchsin, paraldehyde fuchsin, periodic acid Schiff and acid phosphatase methods were also applied in parallel.[3,4]

Large number of argentophilic granules of lipofuscin were seen stained in the perikarya of the nerve cells and in the interneuronal structures. In the cerebral cortex, the nerve cells contained the granules which were clustered together (Fig. 1) while in the rest of the brain, the nerve cells mostly contained the dispersed granules (Figs. 2, 3, 4). The results of staining with other methods used in parallel showed that the silver staining procedure was mostly staining the neuronal lipofuscin granules. Both procedures of silver impregnation, *i.e.*, one including permanganate oxidation prior to silver impregnation and the other omitting oxidation prior to silver impregnation, stained all the granules alike, *i.e.*, dot like having a clear halo around (Figs. 3, 4) and this was true for all areas of the brain examined, *viz.*, cerebral cortex, striatum, thalamus, cerebellum, medulla, etc. The diameters of the stained granules in the oxidised and the unoxidised preparations were found to be the same. Overall brightness of the stained granules, however, was more in the oxidised sections (Fig. 4). It was, therefore, clear that the permanganate oxidation did not bring about any reversal of staining between the inner and outer layer of the granule, *i.e.*, the outer clear halo seen around the individual granules in the unoxidised sections did not become stainable after oxidation. This is contrary to what was reported to have been noticed in the human nervous lipofuscin,[1,2] and so the credited value of this method for conspicuously staining the outer layer or halo of the granule, and thus conclusively demonstrating the existence of two concentric layers of differing chemical compositions in the lipofuscin granules appears to be limited.



FIGS. 1–4. Fig. 1. Section of the cerebral cortex of the brain of parrot (*Psittacula krameri*) treated with silver diaminohydroxide impregnation procedure after potassium permanganate oxidation. Note the clustered granules in the perikarya of neurones, × 300 approx. Fig. 2. Section of the cerebellar cortex of the brain of parrot stained as in Fig. 1, Note the dispersed granules stained as solid dots having clear halo around, × 800 approx Figs. 3–4. Sections of some area in the brain stem of parrot. These two sections were exactly adjacent. Fig. 3 depicts the results of unoxidised section impregnated, while Fig. 4 depicts the result of oxidised section impregnated similarly. In both sections the same granules took up the deposits of silver and were stained dot like with clear halo around each granule. Note darker staining in Fig. 4, × 800 approx.

It would be worthwhile to further consider whether the clear halo seen around the stained granules in the light microscopic observations may be supposed to be representing an unstained, chemically distinct part of the granule. In this context reported electron microscopic observations on the ultrastructure of the lipofuscin granules[5,6] would be of much significance, because electron micrographs do not at all show that there can be such type of layered structure present in the lipofuscin granule. So, the clear halo around the stained granules may be considered more of an artifact or an optical effect than a real structure, and the concept of concentric layered structure for a lipofuscin granule advanced on the basis of light microscopical observations be regarded extremely doubtful.

As the lysosome and lipofuscin granules are very much related[6,7] and they may even be identical,[8] it would also be significant to note that recently Capanna *et al.*[9] have stained the lysosomes in various tissues with silver hexamethylenetetramine following oxidation of the tissue sections with sodium periodate and their published pictures of this study did not show the lysosomes stained as circles. These findings further support the present observations of the avian brain, and so how the clear halo seen around the stained granules in the unoxidised sections could take up a positive stain in the human nervous lipofuscin[1,2] needs further examination.

The author gratefully acknowledges his thanks to Prof. M. B. Lal, University of Lucknow, for the part of this work done at the Lucknow University. and to Prof. L. S. Ramaswami, for the present research facilities.

Dept. of Zoology, RAMESHWAR SINGH.
University of Rajasthan,
Jaipur (India), October 3, 1969.

---

1. Nassar, T. K., Issidorides. M. and Shanklin, W. M., *Stain Technol.*, 1960, **35**, 15.
2. Issidorides, M. and Shanklin, W. M., *J. Anat. (London)*. 1961. **95**, 151.
3. D'Angelo, C., Issidorides, M. and Shanklin. W. M., *J. Comp. Neural.*, 1956, **106**, 487.
4. Pearse, A. G. E., *Histochemistry, Theoretical and Applied*, Churchill Ltd., London. 1960.
5. Samorajski, T., Keefe. J. R. and Ordy. J. M., *J. Cell. Biol.*, 1965, **26**, 779.
6. Hibbs, R. G., Ferrans. V. J., Walsh. J. J. and Burch, G. E, *Anat. Rec.*. 1965, **153**, 173.
7. Samorajski, T., Ordy, J. M. and Keefe, J. R., *J. Gerontol.*, 1964, **19**, 262.
8. Srebro, Z., *J. Comp. Neurol.*, 1966, **126**, 65.
9. Capanna E, Civitelli, M. V.. De Martino. C. and Procicchiani, G., *Experientia*, 1966, **22**, 114.

ON THE OCCURRENCE AND SEASONAL DISTRIBUTION OF *ACARTIA PLUMOSA* T. SCOTT (COPEPODA : CALANOIDA)—A NEW RECORD FOR THE WEST COAST OF INDIA

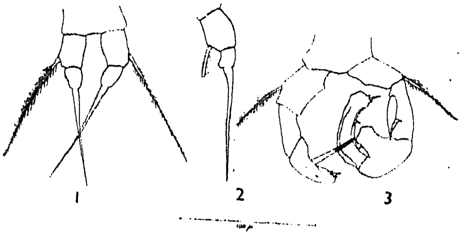
Acartia plumosa was first recorded from the Gulf of Guinea by T. Scott in 1894 ;[1] later from Salt Lakes, Calcutta, by Sewell in 1932[2] and from Sea of Japan by Brodsky in 1950.[3] In plankton collections taken from the Cochin Backwater (Lat. 9° 58′ N., Long. 76° 17′ E.) during 1968–69, this species was found to occur in considerable numbers in January and February. From then onwards its numbers dwindled till it was totally absent in July and August. It started appearing again in September, and in October and November the family Acartiidæ in the plankton was represented by *A. plumosa* only.

In collections taken from Fairway Buoy, a typically marine area about 3 miles west of Cochin Barmouth, this species was found irregularly in negligible numbers.

Size variation was noticed in those from the Backwaters ; larger specimens being found in October and November and smaller specimens during the rest of the year.

♀ 1·1 mm. ♂ 1·0 mm. (larger)
♀ 0·9 mm. ♂ 0·85 mm. (smaller)

Salient Features.—Small spines on the posterior corners of the 5th pedigerous segment in both sexes. Caudal rami long in female, longer than the last urosome segment. 3rd segment of the female fifth leg has a shelf-like projection in its proximal posterior part (Figs. 1 and 2). Scott's illustration shows a suture distal to this shelf and he refers to the part distal to this suture as 'apical seta'. This suture is not present in this species and the 'apical seta' is the distal part of the 3rd segment beyond the shelf. Brodsky (1950, Fig. 299) shows no suture in this position.



FIGS. 1–3. *Acartia plumosa* T. Scott. Fig. 1. Female fifth feet, anterior view. Fig. 2. Female fifth feet, posterio-lateral view. Fig. 3. Male fifth feet.

A. southwelli Sewell (1914),[4] *A. chilkœnsis* Sewell (1919)[5] and *A. bilobata* Abraham (1969)[6] were found together with *A. plumosa* in the plankton collections taken from Cochin Backwaters and Fairway Buoy. The last three species are referable to Steuer's[7] subgenus *Acanthacartia*. General appearance of the males of these four species is so similar that a correct identification is difficult without intensive study. There are three outstanding characters by which the male of *A. plumosa* can be distinguished from those of the other species : right fifth leg much longer than left ; the spine on the midlength of the inner margin of the last segment of left fifth leg is long and spinulose [Scott (1894) observed no spinules on this spine]; the inner projection on the 3rd segment of the right fifth leg is roughly quadrilateral (Fig. 3), while that of *A. southwelli* is evenly rounded, that of *A. chilkoensis* has a distal process and that of *A. bilobata* is bilobed.

A systematic study of the family Acartiidæ of Cochin Backwaters has enabled the author to record 11 species of this family so far.

I am grateful to Dr. N. K. Panikkar for the encouragement given to me and to Dr. Bowman for critically going through this note.

Indian Ocean Biological Centre,
N.I.O., P.B. No. 1913,
Cochin-18. Kerala, *October* 14, 1969.
SARAMMA ABRAHAM.

---

1. Scott, T., *Trans. Linn. Soc. London, Zoology*, 1894, **6** (1 & II).
2. Sewell, R. S. S., *Mem. Indian Mus.*, 1932, **10**, 395.
3. Brodsky, K. A., *Opred. faune SSSR, Ind. Zool. Inst. Akad. Nauk. SSSR*, 1950, **35**, 1.
4. Sewell, R. B. S., *Spolia Zeylanica*, 1914, **9**, 214.
5. —, *Rec. Indian Mus.*, 1919, **5**.
6. Abraham, S., *Crustaceana*, 1969 (In press).
7. Steuer, A., *Zool. Anz.*, 1915, **45** (9), 392.

A REPORT OF CRASSULACEAN ACID METABOLISM IN *EUPHORBIA CADUCIFOLIA* HAINES AND ITS DIVERSITY

The leafy spurge (*Euphorbia caducifolia*) shows morphological diversity.[4] The physiological diversity in germination of seeds has also been reported in this species.[5] The diversity is also seen in the leaves, which are fleshy and caducous. These leaves are sour and the sour taste does not appear to be equal in the leaves of different individual plants, thus indicating a diversity in the accumulation of acids. The phenomenon of diurnal fluctuation of acidity in the succulent leaves of *Bryophyllum*, termed crassulacean acid metabolism, is also exhibited by all those non-succulent plants which possess high concentration of organic acids.[1-3] Investigations on *E. caducifolia*, which is probably the only species in this genus to have sour leaves, showed only accumulation of acids in them. For the present study, two things have been kept in view: first, how far the acid metabolism of this species stood comparison with the crassulacean type, and second, the diversity with regard to the metabolism of acids in different individual plants.

Samples were collected from two individual plants, one with small lanceolate (S) and the other with large rounded (L) leaves. The plants were specially cultivated in pots for this purpose. The acidity of leaves was expressed in terms of titrable acid number (T. A. N.). For this, 1 g. of fresh leaves were weighed, extracted in 50% alcohol and then in distilled water. The filtrate was titrated against N/50 CO_2-free NaOH using methyl red as indicator. The volume of NaOH required to neutralise the acid present in 1 g. of fresh leaves is expressed as T.A.N.

As the values of T.A.N. indicate only a measure of total acidity, changes in the different acid constituents in the leaf were observed by ascending paper chromatography. The solvent system of *n*-butanol : formic acid : water (10 : 3 : 10) was used for this purpose. Ammoniacal silver nitrate (equal parts of 0·1 N $AgNO_3$ and 0·1 N NH_4OH, prepared freshly) was used as the spraying reagent.[2] The leaf extract for spotting a chromatogram was prepared by digesting 1 g. leaf sample with 10 ml. of 70% alcohol. Different reference solutions of ascorbic, citric, fumaric, malic, oxalic, succinic and tartaric acids were placed to serve as standard on the chromatograms.

For sugars (monosaccharides), the leaves were extracted in 80% alcohol with subsequent clarifications in lead acetate and disodium hydrogen phosphate.[6] pH was determined by an electronic pH meter. All the above-mentioned estimations for fully mature leaves in the month of September in case of two selected plants (S and L) during the day are given in Table I.

Chromatograms of leaf extracts showed the changes in the different acid constituents in leaves to be mainly malic and citric. Following points become evident from Table I.

1. T.A.N. is highest in the leaves after the period of night darkness in the early morning.
2. Total acid percentage increases during the dark period and is maximum early in the morning which reaches a minimum in the evening.
3. pH values of the leaf changed during the day hours.
4. Among the carbohydrates, only monosaccharides were detected, which were maximum in the evening and minimum early in the morning after the darkness of the night.
5. Both malic and citric acids appeared to be utilized during the day hours in sunlight and their concentration was maximum after the dark period of the night.

TABLE I

Fluctuations in T.A.N. percentages of total acids and monosaccharides, and pH in the leaves of E. caducifolia *during the day for two individual plants S and L*

	12 Noon^{+}		8·0 a.m.$^{++}$		12 Noon^{+++}		6·0 p.m.$^{++++}$	
	S	L	S	L	S	L	S	L
T.A.N. ..	0·8	1·0	4·2	4·6	3·2	2·9	0·3	0·4
Total acids ..	0·05	0·06	0·26	0·29	0·20	0·18	0·19	0·02
pH ..	6·4	5·3	6·2	5·0	5·2	5·2	6·2	5·9
Monosaccharides ..	2·70	..	1·35	..	4·05	2·70	6·75	4·05

$^{+}$ Samples from natural light and dark conditions, $^{++}$ Samples after keeping plants in artificial darkness till 8·0 a.m., $^{+++}$ Samples from $^{++}$ collected at 12 Noon, $^{++++}$ Samples from $^{++}$ collected at 6·0 p.m.

6. In the leaves of plant S citric acid seemed to be utilized by the forenoon and there was no trace of it by the evening.

7. Oxalic acid appeared to be constantly present throughout in both the individual plants.

8. There has been a great diversity among all the values in the two plants selected for the present study, although they belong to the same taxon.

The author wishes to express his sincere thanks to Prof. Dr. K. M. Gupta, for facilities and encouragement, and to Messrs. K. D. Sharma and D. D. Chawan, for their assistance in different analytical work.

Botany Dept., DAVID N. SEN.
University of Jodhpur,
Jodhpur (India), *October* 3, 1969.

---

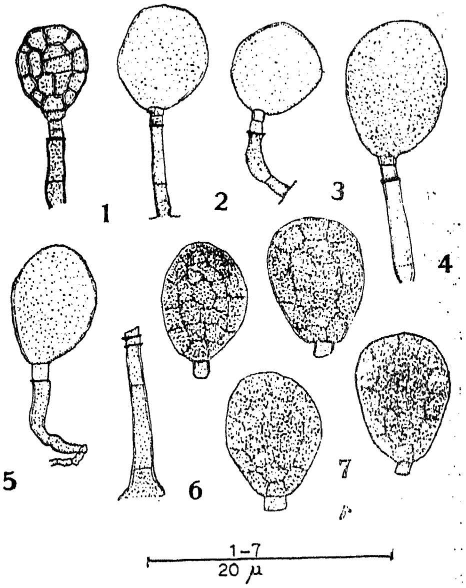
1. Bennet-Clark, T. A., *New Phytol.*, 1933, **1, 2, 3, 37**, 128, 197.
2. Black, R. J., Durrum, E. L. and Zweig, G., *A Manual of Paper Chromtography and Paper Electrophoresis*, 1958.
3. Ranson, S. L. and Thomas, M. *Ann. Rev. Plant Physiol.*, 1960, **11**, 81.
4. Sen, D. N., *Folia Geobot. et Pytotax.*, 1968, **3**, 1.
5. —, *Proc. Recent Adv. Trop. Ecology*, 1968, p. 202.
6. Somogyi, M., *J. Biol. Chem.*, 1945, **160**, 61.

A NEW *ACRODICTYS* FROM INDIA

ELLIS[1] proposed *Acrodictys* with *A. bambusicola* as type, and in addition described nine species under it to take in a dematiaceous form producing conidiophores singly or in groups forming at apex conidia as blown-out ends with transverse and longitudinal septa in which the conidiophores proliferate through the scar to form another conidium at a higher level. Later Ellis[2,3] added three more species to it. In this communication a new *Acrodictys* is described collected by the author during the studies on the Hyphomycetes of Hyderabad.

Acrodictys satwalekeri sp. nov. (FIGS. 1–7)

This fungus produces effuse, light blackish-brown to black colonies on the substratum. Mycelium is partly superficial or partly immersed in the substratum, reticulate, subhyaline to dark brown, branched, septate, smooth-walled, 2·8–3·6 μ thick. Conidiophores originate laterally and singly or in groups of 2–3 from this mycelium, straight, erect or slightly flexuous, brown to dark brown at base while the upper part is usually paler, smooth-walled, 0–3 septate. 25·2–36 μ long, 3·6–7·2 μ broad at base and upto 3·6 μ broad in the apical region. The conidiophore proliferates terminally, 1–3 proliferations were observed.



FIGS. 1–7. *Acrodictys satwalekeri* sp. nov. (from type material V.V.C.B.L. No. 782). Fig 1. Conidiophore with young conidium. Figs. 2–5. Conidiophores with conidia. Fig. 6. Proliferated conidiophore. Fig. 7. Conidia with basal cell.

Conidia are formed singly at the apex of the conidiophores, after the first conidium has fallen the conidiophore proliferates through the scar and forms another conidium at a higher level. Conidia are dark blackish-brown and opaque, smooth, oval to subspherical consisting of numerous (15-25) transverse and longitudinal septa (cellular constitution observed in young conidia, in maturity become dark, appearing as a large 1-celled conidium), not constricted at the septa, 21·6-32·5 μ long, 18-25·2 μ thick in the broadest part (18 μ across). The basal cell is protruding, cylindrical, truncate at base, often much paler than the rest of the spore and measures 1·8-3·6 μ long, 2 μ broad.

The above fungus comes nearer to *Acrodictys erecta* (Ell. & Ev.) M. B. Ellis, in having oval to subspherical dark conidia on erect, proliferating conidiophores but differs in having many-celled conidia, short conidiophores, and in their dimensions. Therefore, it is described new as *Acrodictys satwalekeri*, named after Dr. S. D. Satwaleker, former Principal, Vivek Vardhini College.

Type collected on old unidentified stems from Nizamabad on 5-10-1968 Coll. D.R. V.V.C.B.L. No. 782.

Acrodictys satwalekri sp. nov.

Coloniæ effusæ, fuscæ vel atræ. Mycelium partim superficiale et partim immersum, ex hyphis ramosis, septatis, subhyalina vel pallide brunnea, 2·8-3·6 μ crassis. Conidiophora singula, ex lateribus hypharum oriunda, erecta, recta vel flexuosa, brunnea vel atro-brunnea, levia, 0-3 septata, 25·2-36 μ longa, 3·6-7·2 μ crassa, apicem versus ad 3·6 μ attenuata, per usque, ad 3 proliferationes successive elongascentia. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivæ oriunda, ovalia vel subsphærica, pallide brunnea, vel atro-brunnea, levia, septis 15-25 transversalibus et longitudinalibus prædita, 21·6-32·5 μ longa, 18-25·2 μ crassa: cella basilaria apallide brunnea, basi truncata, 1·8-3·6 μ longa, 2 μ crassa.

Sincere thanks are due to Dr. M. B. Ellis, Mycologist, C.M.I., England, for providing literature and to Mr. P. S. Rao, Principal, for facilities.

Department of Botany, DEV RAO.
Vivek Vardhini College,
Hyderabad, A.P., India, *March* 12, 1969.

---

1. Ellis, M. B., *Mycol. Pap.*, 1961, **79**, 5.
2. —, *Ibid.*, 1963, **93** 23
3. —, *Ibid.*, 1965, **103**, **33**.

REVIEWS AND NOTICES OF BOOKS

Sources of Quantum Mechanics. Edited with a Historical Introduction by B. L. Van Der Waerden. (Dover Publications, Inc., New York), 1968. Pp. xi + 430. Price $ 3.00.

This Dover edition, first published in 1968, is an unabridged republication of the work published in 1967 by North-Holland Publishing Co., Amsterdam. Reprinted by special arrangement with North-Holland Publishing Co.

Although Max Planck's famous lecture of 1900 gave quantum theory its essential form, the theory as he stated it was just the beginning. In this book, Professor van der Waerden collected 17 early papers which developed quantum theory into the form in which we know it. These papers appeared from 1917 to 1926, and were written by many of the leading physicists of the early 20th century.

The collection begins with Einstein's "On the Quantum Theory of Radiation," an illuminating derivation of Planck's Law. Other important early papers by Ehrenfest, Bohr, Born, Van Vleck, Kuhn, and others prepared the way for the "turning point" in quantum mechanics. This crucial step is expressed in Heisenberg's paper "Quantum-Theoretical Re-Interpretation of Kinematic and Mechanical Relations." 11 of the 17 papers in the collection are reproduced unabridged. C. V. R.

Plant Physiology, By R. M. Delvin. (An East-West Edition.) (Van Nostrand Reinhold Company, New York, London, Toronto. Melbourne—Affiliated East-West Press Pvt. Ltd., New Delhi-3.) Pp. xi + 564. Price Rs. 16·50.

A book on plant physiology is a specialized work in a generalized field. An introductory book on this subject therefore presents the author with the difficult problem of making sure that the student is as aware of the wood as he is of the trees. The author has achieved this by devoting the first eight chapters to the fundamental processes of physiology, illustrating his remarks with examples drawn from the plant kingdom. A chapter on the translocation of sugars then forms a natural bridge to three chapters on the photosynthetic process and photosynthetic structures, in which Prof. Delvin presents a clear account of contemporary theory well documented by references to the literature. This is followed by an extensive treatment of mineral metabolism, nitrogen metabolism, and hormones, with chapters on photoperiodism, vernalization, and dormancy. The extensive bibliography which terminates each chapter gives an opportunity for reading assignments on the organization of seminars.

The book is richly illustrated and there are numerous references at the end of most of the chapters furnishing sources of more detailed information to the student. The price is very reasonable.

C. V. R.

Breeding Asian Field Crops. By J. M. Poehlman and D. Borthakur. (Published by Oxford and IBH Publishing Co., Park Hotel Buildings, 17, Park Street, Calcutta-16), 1969. Pp. 385. Price Rs. 18.

This book is a revision and adaptation of the well-known book, *Breeding Field Crops*, by the first author published in U.S.A. for use in American Universities for undergraduate students of agricultural colleges. Although widely used elsewhere also, many of the examples in this original edition do not apply in the tropical climates where crops and crop varieties are vastly different, and where agriculture is less developed and less mechanized. The revised edition concentrates on the principles, procedures, and problems in the breeding of field crops in the south and south-east Asia. Practical examples have been chosen from local agriculture wherever possible.

The first few chapters are devoted to the necessary fundamentals of the botany of field crops, general principles of genetics, and the methods and techniques of breeding. Then in separate chapters the breeding of each of the following crops is dealt with in detail: Wheat, Rice, Maize, Sorghum, Millets, Cotton, Sugarcane, Potato, Jute, Tobacco, Pulses, Oilseeds and Forage Crops. The last chapter deals with seed production practices. The book is amply illustrated.

Besides its primary use as a text-book on plant breeding for students and teachers of agriculture, it will serve as a reference book for plant breeders working in the field. In the present context of the "green revolution" witnessed and talked about much the book should appeal to the interested layman also. Dr. B. C. Pal and Dr. M. S. Swaminathan have written Forewords to the publication.

A. S. G.

Chemical and Botanical Guide to Lichen Products. By Chicita F. Culberson. (The University of North Carolina Press, Chapel Hill, U.S.A.), Pp. 628. Price $ 12.50.

The known lichen products include hundreds of compounds many of which are restricted to the lichens. Renewed research activities have been witnessed during the past decade on the chemistry, taxonomy, and physiology of these symbiotic organisms. In the present context this new publication will be welcomed by all workers in this field.

The book presents a useful guide to the vast and widely scattered literature on the subject. The book is in five chapters. After the introductory first chapter the second chapter describes the nature of lichen products, their biogenesis, and their relationships to the products of non-lichen-forming fungi. Chapter III lists some 300 lichen constituents with physical data, chemical structures, and annotated references. Chapter IV gives a summary of the occurrence of the compounds in the genera of lichens. The last Chapter V lists the occurrence of about 2000 species, varieties, and forms of lichens.

The book is an invaluable aid to botanists, chemists, and medical researchers.

A. S. G.

Books Received

British Ecological Society Symposium No. 9—Ecological Aspects of the Mineral Nutrition of Plants. Edited by I. H. Rorison. (Blackwell Scientific Publications, 5, Alfred Street, Oxford, OXI 4 HB, England), 1969. Pp. xxi + 484. Price £ 5.0.0.

Introduction to the Chemistry of Life—Organic Chemistry. By H. D. Embree. (Addison-Wesley Publishing Co., Reading Mass), 1969. Pp. xi + 208. Price 35 *sh.*

The Grammar of Mathematics. By L. K. Durst. (Addison-Wesley Pub., 11, Hills Place, London W. 1), 1969. Pp. xi + 178. Price 46 *sh.*

1811-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

Phone : 572305 Grams : 'TEMPOVEN, SZ

Precision stabilized

THERMISTORS

Now manufactured in India by:

TEMPO INDUSTRIAL CORPORATION

18-C, Paranjape 'B' Scheme,
Subhasha Road, Vile Parle (East),
BOMBAY 57 AS.

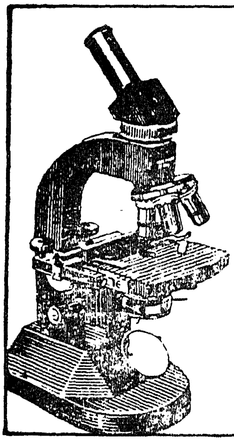
Types available :

BEADS	PROBES
* MICRO BEADS	* GLASS PROBES
* BARE BEADS	* STAINLESS STEEL PROBES
* EPOXY COATED BEADS	* TEFLON PROBES

Disc Thermistors for Transistor Radios &

CERAMIC MAGNET.

IRL **OPTICAL INSTRUMENTS**



microscopes
students' • laboratory
research • metallurgical
dissecting • travelling

microscope attachments

spectrometer

telescope

GHARPURE & CO.

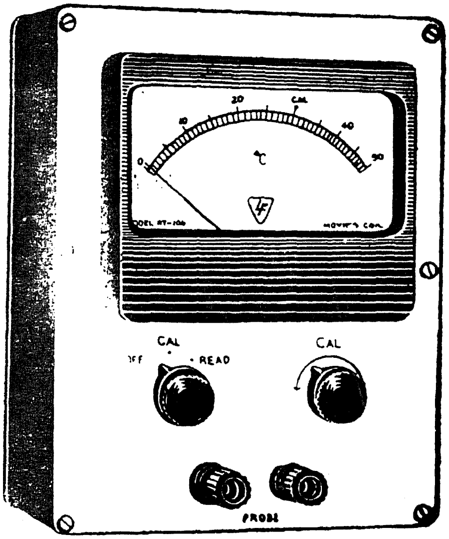
P-36 India Exchange Place Extension, Calcutta-1
Gram : MEENAMO • Phone : 22-2[illegible]

LI-066 Electronic Telethermometer

Flexible Probes
Remote Indicating

High Accuracy
Portable & Compact

Direct Reading
Reads within 5 secs.



Single Channel and Multi-channel.
Available for temperature ranges from

0° to 100° C. ± 0·2° C.

Contact :

Laboratory Furnishers

DHUN MANSION, VINCENT ROAD
BOMBAY-14
TEL.: 442761 GRAM: "LABFURNISH"
Branch Office :
KAPASIA BAZAR, AHMEDABAD-2

SP/LF/10

THE NEW MALADY OF COFFEE IN SOUTH INDIA

V. AGNIHOTHRUDU

Technical Adviser, Rallis India Limited, 6 A, Cunningham Road, Bangalore-1 B

IS there a new malady of coffee? Perhaps there is. Table I gives the acreage of Arabica Coffee and the crop in tonnes from the Mysore State in the last 8 years, which is apparently stagnant.

TABLE I

Arabica coffee acreage and yields in Mysore State

Year	Acreage	Yield
1960-61	..	33,0 3
1961-62	..	21,481
1962-63	1,14,712	26,752
1963-64	1,19,028	32,671
1964-65	1,26,040	33,165
1965-66	1,29, 74	31,704
1966-67	1,29,608	33, 00
1967-68	1,28,317	31.570

The crop for 1969-70 is likely to be around 30,000 tonnes.

With the greater care and attention now being bestowed on coffee plantations from 1950 onwards, together with the increased acreage and the considerably large stand of high yielding station selections (30% or more of Arabica) a great increase in the crop is naturally expected. In 1960-61 the Arabica crop was 33,073 tonnes. The crop on average for the last seven years is only about 30,000 tonnes. The 1966-67 is a bumper year for the coffee crop, which totalled 76,000 tonnes, of which 33,500 tonnes was Arabica for Mysore and Coorg. Though this is a record crop, the Arabica contribution is about the same for 1960-61 and 1964-65 seasons, in spite of the complement of high yielding station selections being more by at least 15,000 to 16,000 acres.[1]

From observations conducted over several years we find the death of leaves one or two nodes below the terminal bud as the leading symptom of the new malady.

There are many types of die-back in coffee-Overbearing die-back, leaf disease die-back, hot and cold, Lyamungu die-back, Top die-back and Elgon die-back. Of these Elgon die-back has certain striking similarities with the new malady. The one characteristic feature of Elgon die-back[2] is the death of nodal and inter-nodal tissues usually several nodes from the apex. This appears to be the basic characteristic of the die-back seen in Mysore also. In the case of Elgon die-back no particular association between the death of leaf and the initiation of a nodal lesion has been noticed, but, at least on occasions it does occur and in Mysore more often than not this is the case. Thorold considered this as a form of carbohydrate deficiency and was able to ameliorate it to a certain extent by providing adequate shade. But, Dr. J. C. F. Hopkins (*in litt.*), the then Director of the Commonwealth Mycological Institute in the U.K., observed plenty of starch reserves in the affected twigs and isolated a strain of *Colletotrichum* which produced the perfect stage, *Glomerella cingulata* (Stonem,) Spauld. *et* V. Schrenk, in culture. The same fungus occurs in South India also. Nutman *et al.* (1966 *in litt.*) found that strains of *Colletotrichum* which caused coffee berry disease could invade a branch tissue and produce symptoms like those of Elgon die-back, but, as these strains are not isolated from Elgon die-back occurring regions or from a locality which is free from coffee berry disease, it is doubtful whether the coffee berry disease strain is the natural cause of the die-back.

A whole gamut of the following symptoms has been described for the new malady of Coffee in South India.

(1) Death of the terminal bud or leaves on tertiary system of branches (new years cropping wood). (2) Blackening of the petiole on one or more functional leaves usually on one side of the node. (3) Malformation of new flush like crinkle leaf reported from Kenya[3] (*loc. cit*). (4) Nodes get twig closer towards the top of branches. (5) From the above nodes numerous new laterals arise giving a fan-shaped appearance. These growths are brittle. (6) Abortion of the primary and some axillary buds. (7) Goose necking of the tertiary branches. (8) Brown to black discoloration of the pith with or without cell disorganisation. (9) Scorching of the flower-buds and blossom. (10) The non-development or uneven development of berries. (11) Chlorosis of the functional leaves.

The obvious characteristic of the new malady as stated earlier is the death of a node and this localisation of symptom very strongly suggests the entry of a pathogen particularly through the leaf base and/or leaf scar.

In microscopic preparations of the twig marked decay of pith was observed although the twig for all external purposes was healthy. This suggests that the onset of the condition took place perhaps before the external symptoms are manifested. In some instances the water-conducting tissues are plugged with gum and tyloses both of which are associated with wound reaction. Die-back is present almost in all places where Arabica is grown, but, it would appear that it is less on plantations of rust-resistant coffee and worst on old coffee which generally suffers from heavy defoliation, due to leaf disease.

Any cultural practices which increase the stored nutrients of the coffee bush relative to the crop level can be expected to ameliorate the die-back. The increase in food reserves can be brought about by judicious cultural methods that might tend to increase the leaf complement on the trees and/or by lengthening of the life of the coffee leaves themselves.

TABLE II

Percentage occurence of colletorichum coffeanum

	Dead plants	Plant parts apparently healthy	
	Surface sterilized	Surface sterilized	Surface not sterilized
Root ..	Nil	Nil	Nil
Twig (internode)	14	Nil	22
Twig (node) ..	78	3	19
Lamina ..	18	Nil	38
Petiole ..	64	Nil	27

In our studies we have isolated *Colletotrichum coffeanum* Noack from plant parts both surface sterilised and surface not sterilised.

From Table II it will be clear that the roots are free from the fungus. In dead twigs, *Colletotrichum* is the predominant fungus that has colonised. Its presence on surface sterilized nodes of apparently healthy plants would mean that the fungus is in a latent phase and its occurrence in the lamina and petiole of apparently healthy plants not surface sterilized would mean that the fungus is an important member of the phyllosphere.

For all practical purposes apart from trying to discover the causative agents it might be worthwhile to concentrate more on the control measures at this stage.

It is true that nowadays more than 2 fungicidal sprays are necessary to keep coffee bush in good health. It is not because any phenomenal increase in the crop returns are achieved by these sprays, but, purely to prevent progressive deterioration of the bushes in affected areas. The increased number of sprays are not because the planters have become fastidious about the standards of health of their coffee bushes, but they are afraid of an unknown condition in coffee which they fear is withholding their crops. Planters are above all becoming aware of the need to spray selections also although they may not get the leaf disease to the same degree as the old coffee. They feel that a copper spraying does them good.

It has always been intriguing to see small holdings not suffering from ravages of the new malady, which may be due to thorough drenching of the bush by Bordeaux mixture (800–1,000 gallons per acre).

In our observations we have seen that there is heavy sporulation of fungi particularly *Colletotrichum* with the first showers in April/May period. In order to reduce the initial inoculum a pre-blossom spray in March was advocated on the results of our trials and this seems to have considerably improved the health of the bushes. Recent work by Hocking (1966)[4] on the general role of *Colletotrichum coffeanum* other than the coffee berry disease strains indicated that the fungus is confined to colonisation of dead, moribund tissues with sporadic active parasitism, under some local conditions. Any recommendations on disease control should be based on the consideration of economics particularly in the light of present trends of increasing costs of labour, manure, pesticides, etc. For example in the coffee leaf disease it is necessary to know to what level the rust should be controlled to prevent crop losses of economic importance. The low volume spraying techniques now employed even in East Africa have not reduced the leaf disease to the same extent as could be achieved by the conventional high volume sprays, but, there even at 20 gallons per acre, the rust is as low as 20% or even lower. From the dosage response curves it is evident that considerably higher concentrations than what are generally used may be necessary to achieve a really higher degree of control. The leaf disease control in India, it is true, leaves much to be desired. How many estates in Mysore are able to achieve a 50% control of the leaf disease? May be none. The best of the estates are probably achieving 30 to 40% and the others hardly 20% control on their old coffee.

With reference to coffee berry disease, the work done by Wallis and Firman[5] reveals that the volume of spray did not affect greatly the deposit retained on the branch surfaces.

Branches were able to retain upto 250 ml. copper per sq. meter and it is considered that a volume equivalent to 100 gallons per acre would provide the greatest margin of safety to compensate for inaccuracies in application. In East Africa there have been reports of increased coffee berry disease with increasing number of sprays which may be due to increased leaf retention creating favourable microclimate for the multiplication of the pathogen.

Insufficient application, wrong timing and dosage, all these invariably result in a disease incidence greater than on trees which have not been sprayed at all. Strange as it might appear this is nevertheless true. Maybe this is a result of retention of infected leaves with heavy source of inoculum, which otherwise would have normally fallen. In India the close spacing of coffee and the forgotten practice of pruning make leaf disease control extremely difficult and perhaps ineffectual. The following few suggestions deserve critical reconsideration as far as the new malady is concerned:

(1) Establishment of the causative agent and its life-cycle.

(2) What is the optimum time, quantity of copper to be put in? Maybe 3 full sprays are necessary, the first being a pre-blossom one.

(3) It may be necessary to increase the number of spraying to 4 to 5 as the residual effect of copper formulations wear off in 3 to 4 weeks. A clearer picture can emerge only when we have decided upon the optimum spacing of the bushes. Trials are necessary to find if the degree of leaf retention has anything to do with the freedom from the new malady.

(4) Protection of leaves from the ravages of pests such as thrips at a time when bushes which have suffered heavy defoliation or bushes which have been heavily pruned are recovering.

(5) Manurial requirements of coffee under different conditions to offset the disadvantages of heavy carbohydrate drain during an acute leaf disease incidence or heavy crop or both. Apart from mere soil analysis data the need for plant analysis is stressed.

(6) The need for a thorough investigation of optimum shade requirements for coffee in different districts in South India and a reassessment of the necessity of pruning bushes on individual merit as a corrective sanitation practice.

ACKNOWLEDGEMENTS

I am grateful to the General Manager, Fertiliser and Pesticides Division, Rallis India Limited, for permission to publish this article.

---

1. Agnihothrudu, V.. *Final Report of the Special Coffee Research Association*, 1968, p. 107.
2. Thorold, C. A., *East African Agric.*, 1945, **3, 198.**
3. Wormer, T. M. and Firman, I. D., *Kenya Coffee*, 1961. p 31.
4. Hocking. D., *Ann. appl. Biol.*, 1966, **58,** 409.
5. Wallis, J. A. N. and Firman, I. D., *Ibid.*, 1967, **99, 11.**

IMPACT OF QUENCHING FROM MELT ON EQUIATOMIC ALUMINIUM-GERMANIUM ALLOY

C. SURYANARAYANA AND T. R. ANANTHARAMAN

Department of Metallurgy, Institute of Technology, Banaras Hindu University, Varanasi-6

ABSTRACT

Rapid solidification of equiatomic aluminium-germanium alloy is shown to result in the formation of a new non-equilibrium intermediate phase that can be indexed on the basis of a large tetragonal cell ($a = 14 \cdot 98$ Å, $c = 16 \cdot 03$ Å, $c/a = 1 \cdot 070$) with a possible 208 atoms. The structure of this phase is discussed in relation to the equilibrium f.c.c. solid solution.

INTRODUCTION

QUENCHING of liquid metals and alloys at extremely high cooling rates (10^6 to 10^8 deg.c/sec) has been shown to lead to the formation of a large number of new intermediate phases, supersaturated solid solutions and microcrystalline as well as amorphous phases, in various binary and ternary systems. This technique, generally referred to as 'liquid quenching', 'splat quenching', or 'splat cooling', has been found very effective in filling up gaps in metallurgical equilibrium diagrams, which according to the well-known Hume-Rothery Rules for alloying should contain electron compounds at certain fixed electron concentrations per atom. A number of such Hume-Rothery compounds have been synthesized in many of the noble metal systems and a large number of reviews[1-4] are presently available on non-equilibrium phases obtained by quenching from the melt.

The aluminium-germanium system is a simple one featuring a eutectic reaction at 424° C. and 30·3 at.% Ge. The maximum solid solubility of Ge in Al is 2·8 at.% at the eutectic temperature and Ge has been reported[5] to dislove a maximum of 0·93 at.% Al at 575° C., *i.e.*, well above the eutectic temperature. Predecki *et al.*[6] reported briefly on the formation of a complex unidentified phase in a rapidly solidified Al-30 at.% Ge alloy. The structure of this phase has been shown by us[7] to be tetragonal with $a = 13 \cdot 03$ Å, $c = 12 \cdot 04$ Å and $c/a = 0 \cdot 924$. A similar structure has very recently been reported by Ramachandrarao and Anantharaman[8] for a non-equilibrium phase obtained by splat-cooling a Au-27 at.% Ge alloy.

We report here on the formation of another intermediate phase in the Al-Ge system, which occurs on subjecting an Al-50 at.% Ge alloy to rapid solidification.

EXPERIMENTAL PROCEDURE

The equilibrium Al-Ge alloy was prepared in the same way as described earlier.[7] After melting the alloy, it was given a homogenization anneal in vacuum at 300° C. for 120 hours. The technique of rapid quenching from the melt has been described earlier.[7] In the present investigation it consisted of loading 20–50 mg. of the alloy into a graphite crucible with a nozzle below, which was preheated with the aid of a resistance furnace to 700° C., about 60° C. above the liquidus temperature for the alloy. The molten droplet of the alloy was then shot onto a highly polished copper substrate kept at room temperature by means of a shock wave generated by the rupture of a mylar diaphragm with argon gas at a pressure of 500 lb./sq. in. The resultant products were very thin foils of varying thickness and could be easily removed from the substrate by gently tapping the latter. The whole process does not seem to introduce any plastic deformation in the sample. In some regions, the foil was thin enough (< 1000 Å) for direct electron-microscopic examination.

X-ray specimens could be prepared by sticking flakes of the quenched alloy onto a glass fibre with the help of 'Quick Fix'. Debye-Scherrer photographs were recorded in a Philips 114·6 mm. diameter camera with nickel-filtered CuK_α radiation ($\lambda_{\mathrm{CuK}\alpha} = 1 \cdot 54051$ Å). The interplanar spacings were arrived at from an average of 3 or 4 readings, each recorded after applying correction for film shrinkage.

TABLE I

Observed and calculated $\sin^2\theta$ values for the non-equilibrium phase in aluminium-50 at.% germanium alloy

Structure : Tetragonal

Lattice parameter : $a = 14 \cdot 98$ Å $\simeq \sqrt{13}\, a_{\mathrm{FCC}}$

$c = 16 \cdot 03$ Å $\simeq 4\, a_{\mathrm{FCC}}$

$c/a = 1 \cdot 070$

hkl	$\sin^2\theta_{\mathrm{cal.}}$	$\sin^2\theta_{\mathrm{obs.}}$	$\mathrm{I_{obs.}}$
040	0·0423	0·0433	vvw
133	0·0473	0·0174	w
024	0·0475		
042	0·0515	0·0514	vw
240	0·0529	0·0545	s
115	0·0631	0·0631	vvw
333	0·0684	0·0661	w
151	0·0711	0·0726	ms
440	0·0846	0·0846	s
117	0·1186	0·1172	w
064	0·1322	0·1333	vvw
460	0·1375	0·1385	vw
371	0·1557	0·1552	vw
028	0·1586	0·1596	vw
446	0·1679	0·1677	vw
373	0·1742	0·1738	vw
464	0·1745		
266	0·1890	0·1882	vvw
282	0·1891		
119	0·1926	0·1957	vw
571	0·1980		
480	0·2116	0·2124	vvw
284	0·2169	0·2169	vvw
664	0·2274	0·2256	ms
068	0·2433	0·2465	vvw
177	2·2456		
484	0·2486		
680; 0, 10, 0	0·2645	0·2679	ms
377	0·2667		
359	0·2773	0·2787	w
773	0·2800		
4, 10, 0	0·3068	0·3087	vvw
577	0·3091		
088	0·3173	0·3178	vvw
288	0·3279	0·3295	vvw
197	0·3302		
668	0·3385	0·3391	vw
880	0·3386		
46, 10	0·3688	0·3662	vvw
04, 12	0·3754	0·3759	vvw
884	0·3756		
688; 0, 10, 8	0·4125	0·4115	vvw
28, 10	0·4145		

s = strong; ms = medium strong; w = weak; vw = very weak; vvw = very very weak.

EXPERIMENTAL RESULTS

The X-ray powder photographs revealed a large number of extra reflections along with comparatively weaker reflections from the equilibrium Ge solid solution. Some of the extra reflections were diffuse, but reliable estimates of interplanar spacings could be arrived at by taking several readings from different films. All the extra reflections could be satisfactorily indexed on the basis of a tetragonal unit cell with $a = 14 \cdot 98$ Å, $c = 16 \cdot 03$ Å and $c/a = 1 \cdot 070$. Table I brings out the good agreement between the observed and calculated values of $\sin^2\theta$ for this new structure. Only the first thirty reflections along with their intensities are recorded in this table.

The extra reflections due to the new phase disappeared completely after short annealing treatments at 300° C. and the X-ray patterns reverted to those from a mixture of the two equilibrium phases.

DISCUSSION OF RESULTS

The present investigation has again brought out the tremendous potentiality of the splat-cooling technique in producing new intermediate phases in alloy systems. The structure reported here pertains to the second non-equilibrium phase so far discovered in the Al-Ge system, the first one being the phase reported by us earlier.

Just like the earlier tetragonal structure reported for the Al-30 at.% Ge alloy,[7] the present structure may also be considered as related to the parent Al-solid solution (Fig. 1). The face diagonal of the rectangle obtained by stacking three f.c.c. unit cells in one direction and two f.c.c. unit cells in a direction perpendicular to the same may be taken to constitute the '*a*' parameter of the tetragonal unit cell (*i.e.*, $a_{\text{Tet}} \simeq \sqrt{13}\, a_{\text{FCC}}$). The '*c*' parameter is approximately four times the f.c.c. lattice parameter (*i.e.*, $c_{\text{Tet}} \simeq 4a_{\text{FCC}}$). It is clear from Fig. 1 that reflections characteristic of the f.c.c. structure (*i.e.*, all odd or all even indices) may be expected to predominate, if not occur exclusively. Table I shows, in fact, that the f.c.c. extinction rules are strictly followed.

Assuming that the new tetragonal structure displays the same packing efficiency as the f.c.c. solid solution, its unit cell made up of 52 f.c.c. unit cells ($\sqrt{13} \times \sqrt{13} \times 4$) may be expected to contain (52×4), *i.e.*, 208 atoms per unit cell. On this basis the mean atomic volume for this structure works out to $17 \cdot 3$ Å,^{3} which is almost identical with the extrapolated atomic volume ($17 \cdot 4$ Å^3) for a hypothetical f.c.c. Al-50 at.% Ge alloy.[9] It is worth recalling in this connection that such an assumption on close packing has successfully explained the structural characteristics of not only the Al-Ge phase reported by us earlier,[7] but also quite a few non-equilibrium phases in the Ag-Ge and the Au-Ge systems.[1]

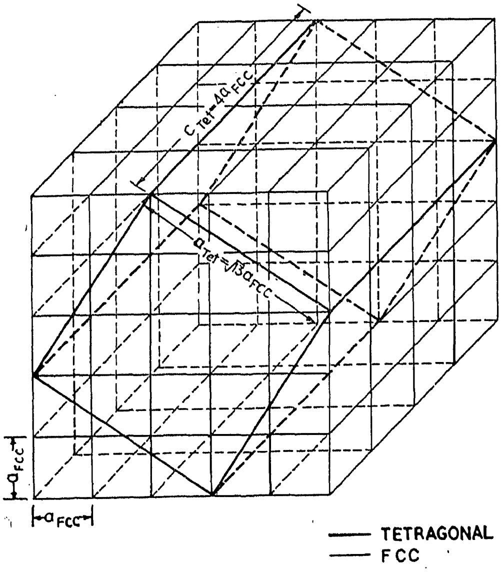


FIG. 1. Formation of the large tetragonal unit cell of the new Al-Ge phase with $a_{\text{Tet}} \simeq \sqrt{13} a_{\text{FCC}}$ and $C_{\text{Tet}} \simeq 4a_{\text{FCC}}$ from 52 unit cells of the f.c.c. solid solution.

---

1. Pol Duwez, *Prog. Solid State Chem.*, 1966, **3**, 377.
2. Giessen, B. C., *Strengthening Mechanisms: Metals and Ceramics*, Ed. Burke, J. J., Reed, N. L. and Weiss, V., Syracuse University Press, New York, 1966, p. 273.
3. Pol Duwez, *ASM Trans. Qly.*, 1967, **60**, 607.
4. Ramachandrarao, P., "Structural studies in metals and alloys rapidly cooled from the melt," *Ph.D. Thesis*, Banaras Hindu University, 1968.
5. Elliott, R. P., *Constitution of Binary Alloys*, First Supplement, McGraw-Hill Book Co., Inc., New York, 1965, p. 38.
6. Predecki, P., Giessen, B. C. and Grant, N. J., *Trans. TMS-AIME*, 1965, **233**, 1438.
7. Suryanarayana, C. and Anantharaman, T. R., *Curr. Sci.*, 1968, **37**, 631.
8. Ramachandrarao, P. and Anantharaman, T. R., *Trans. Ind. Inst. Metals* (In press).
9. Rudman, P. S., *Trans. TMS-AIME*, 1965, **233**, 864.

SIMILAR SOLUTIONS OF COMPRESSIBLE LAMINAR BOUNDARY LAYER EQUATIONS FOR AN AXISYMMETRIC BODY

GIRISHWAR NATH

Department of Applied Mathematics, Indian Institute of Science, Bangalore

ABSTRACT

Similar solutions of the steady laminar viscous compressible fluid at the stagnation point of an axisymmetric blunt body have been studied taking into account the variation of the product of density and viscosity across the boundary layers. The effect of this variation on skin friction and heat transfer is appreciable. The skin friction coefficient increases but the Nusselt number decreases as the total enthalpy at the wall increases.

1. INTRODUCTION

THE solutions of the steady laminar viscous compressible boundary layer equations in the stagnation region of the two-dimensional and axisymmetric bodies have been obtained by Cohen and Reshotko,[1] Levy,[2] and Li and Nagamatsu,[3] taking the product of density and viscosity as constant across the boundary layer. Kemp *et al.*[4] have considered the above problem in the presence of dissociation when the wall is highly cold.

In the present analysis, the solution of the same problem is obtained without imposing any restriction on the variation of the product of density and viscosity, the total enthalpy at the wall, and the Prandtl number. The velocity and the total enthalpy are obtained by numerically solving the two coupled non-linear ordinary differential equations. Further, the skin friction coefficient, the Nusselt number, and the various characteristics of the boundary layer are also obtained.

2. FORMULATION AND SOLUTION OF THE PROBLEM

We shall consider the supersonic viscous flow in the axisymmetric stagnation region of a blunt body. It is assumed that the flow is steady, laminar and axially symmetric. In addition, the fluid is perfect and the wall of the boundary is not very cold. With these assumptions, using the notations of Ref.,[5] the governing equations due to similarity requirements can be expressed as:

$$(Cf'')' + ff'' + \beta\left(\frac{\rho_e}{\rho} - f'^2\right) = 0 \qquad (1)$$

$$\left(\frac{C}{P}g'\right)' + fg' = \frac{u_e^2}{I_e}\left[\left(\frac{1}{P} - 1\right)Cf'f''\right] \qquad (2)$$

with the boundary conditions:

$$f(0) = f'(0) = 0; \quad f'(\infty) = 1$$
$$g(0) = g_w; \qquad g(\infty) = 1 \qquad (3)$$

where

$$\beta = \frac{2S}{u_e}\frac{du_e}{dS}, \quad C = \frac{\rho\mu}{\rho_e\mu_e},$$

and prime denotes differentiation with respect to η.

At the stagnation point,

$$\beta = \tfrac{1}{2} \text{ and } \frac{u_e^2}{I_e} = 0.$$

The density and viscosity are given by:

$$\frac{\rho_e}{\rho} = \frac{T}{T_e} = g; \quad \frac{\mu}{\mu_e} = \left(\frac{T}{T_e}\right)^\lambda; \quad C \quad g^{\lambda-1} \qquad (4)$$

where λ is constant and T is the absolute temperature.

The numerical solution of the coupled equations (1) and (2) with boundary conditions given by equation (3) was carried out on 803, Elliot Computer using Runge-Kutta-Gill method for $\beta = 0 \cdot 5$, $u_e^2/I_e = 0$, $P = 0 \cdot 72$, $\lambda = 0 \cdot 5$, $g_w = 0 \cdot 2$ and $0 \cdot 6$. The velocity and the total enthalpy profiles are given in Fig. 1 and C in Fig. 2. $f'(\eta)$ and $g(\eta)$ increase, but C decreases as g_w increases. If the present results are compared with the corresponding results of Ref.[1], it can be seen that f_w'' and g_w' which determine the skin friction and heat transfer respectively are reduced due to the variation of $\rho\mu$ in the boundary layer.

3. SKIN FRICTION, HEAT TRANSFER AND OTHER BOUNDARY LAYER CHARACTERISTICS

The skin friction coefficient, C_f, at the stagnation point can be expressed as:

$$C_f (R_{cx})^{\frac{1}{2}} = \frac{2^{3/2} f_w''}{(g_w)^{\frac{1}{2}}} \qquad (5)$$

where

$$C_f = \frac{\left(\mu \frac{\partial u}{\partial y}\right)_w}{\frac{1}{2}\rho_e u_e^2}, \quad R_{cx} = \frac{\left(\frac{du_e}{dx}\right)x^2}{\nu_e}$$

is the Reynolds number, du_e/dx is the velocity gradient at the stagnation point in the inviscid

TABLE I

Skin friction coefficient, nusselt number, and other boundary layer characteristics

$\beta=0{\cdot}5,\ u_e^2/I_e=0,\ P=0{\cdot}72,\ \lambda=0{\cdot}5$

g_w	f_w''	g_w'	$C_f\,(R_{ex})^{\frac{1}{2}}$	$N_u/(R_{ex})^{\frac{1}{2}}$	D	M	E	$\bar{E}$
0·2	0·3464	0·1853	2·1905	1·6377	0·0265	0·5071	0·7906	0·5707
0·6	0·6615	0·1519	2·4155	0·8951	0·4555	0·4173	0·0661	0·2716

flow, and ν_e is the kinematic viscosity at the edge of the boundary layer.

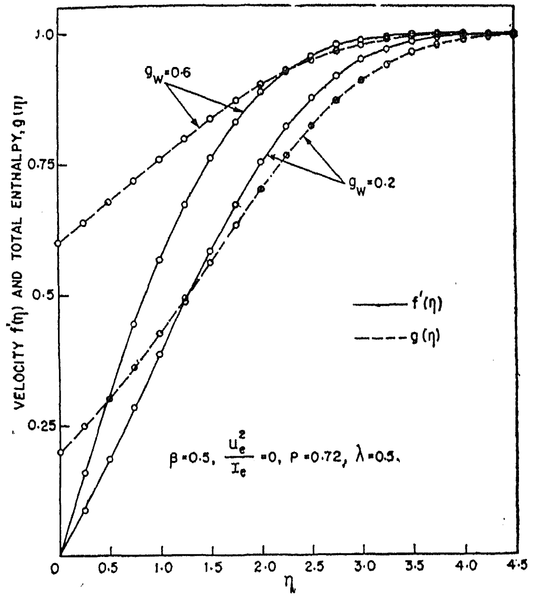


FIG. 1. Velocity and total enthalpy distributions.

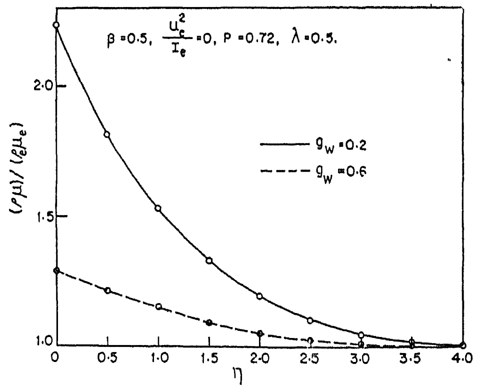


FIG. 2. Variation of $(\rho\,\mu)/(\rho_e\mu_e)$ with η.

Similarly, the Nusselt number, N_u, can be written as:

$$\frac{N_u}{(R_{ex})^{\frac{1}{2}}} = 2^{\frac{1}{2}}\,\frac{g_w'}{g_w\,(1-g_w)} \tag{6}$$

where

$$N_u = \frac{\left(K\frac{\partial T}{\partial y}\right)_w C_p x}{K\,(I_e - I_w)}$$

K and C_p are conductivity and specific heat respectively and they are taken as constant across the boundary layer.

The dimensionless displacement, momentum, enthalpy-defect and energy thicknesses are expressed respectively as:

$$D = \int_0^\infty (g - f')\,d\eta\,;\ M = \int_0^\infty f'\,(1-f')\,d\eta \tag{7}$$

$$E = \int_0^\infty f'\,(1-g)\,d\eta\,;\ \bar{E} = \int_0^\infty f'\,(1-f'^2)\,d\eta$$

The skin friction coefficient, the Nusselt number, the displacement, momentum, enthalpy-defect and energy thicknesses are given in Table I. The skin friction coefficient and the displacement thickness increase, but the Nusselt number, momentum enthalpy-defect and energy thicknesses decrease as the total enthalpy at the wall increases.

4. CONCLUSIONS

1. The Nusselt number, the displacement, and energy thicknesses are much more sensitive to the change in the total enthalpy at the wall as compared to skin friction coefficient, momentum and enthalpy-defect thicknesses.
2. The effect of the variation of the product of density and viscosity on the skin friction coefficient and the Nusselt number is quite appreciable.

---

1. Cohen, C. B. and Reshotko, E., "Similar solution for the compressible laminar boundary layer with heat transfer and pressure gradient," *NACA Rep.* 1293, 1956.
2. Levy, S., *J. Aero. Sci.*, **1954, 21,** 459.
3. Li, T. Y. and Nagamatsu, H. T., *Ibid.*, **1955, 22,** 607.
4. Kemr, N. H., Rose, P. H. and Deltra, R. W., *Ibid.*, **1959, 26, 421.**
5. Dorrance, W. H., ***Viscous Hypersonic Flow***, McGraw-Hill Book Company, Inc., 1962, p. 32,

FRUITING PLANTS FROM *IN VITRO* GROWN LEAF TISSUE OF *RAUVOLFIA SERPENTINA* BENTH.

G. C. MITRA AND H. C. CHATURVEDI
Tissue Culture Laboratory, National Botanic Gardens, Lucknow

COMPLETE studies involving embryoid and plantlet differentiation in *in vitro* grown tissues and their rearing up to complete plants in potted soil are very few. So far, such studies have been made with carrot[1,2] and tobacco[3-5] only. We now report, the raising of fruiting plants of *Rauvolfia serpentina* Benth., a perennial.

The leaf callus explants grown on a modified Murashige and Skoog's[6] agar medium, under controlled conditions of light, temperature and humidity,[7] showed the best differentiation of organized bodies in those cultures receiving kinetin (0·5 mg./l.), or adenine or adenine sulphate (both 10 mg./l.) along with either casein hydrolysate (500 mg./l.) or yeast extract (200 mg./l.) and in presence of coconut milk (10% v/v). The pH of the media were adjusted to 5·5. However, these substances when even used singly were found effective, but to a much lesser extent. The presence of 2, 4-dichlorophenoxyacetic acid was deleterious to organogenesis in every case.

Two ontogenetic pathways were observed in the regeneration of plants from leaf callus, namely, (1) the adventive embryogenesis in which some of the stages of zygotic embryogenesis were recapitulated and (2) the differentiation of the bipolarized meristematic nodules in which the shoot and the root-growing points were established on their two poles (Fig. 1, A, B). These two types of *regenerants* were formed from meristemoids which occurred as isolated pockets of meristematic cells in the same proembryogenic tissue. The earliest stage in the differentiation of a *regenerant* that could be noticed was a twelve-celled meristemoid (Fig. 2). The other organized bodies differentiated in cultures included roots, shoot-buds and certain malformations.

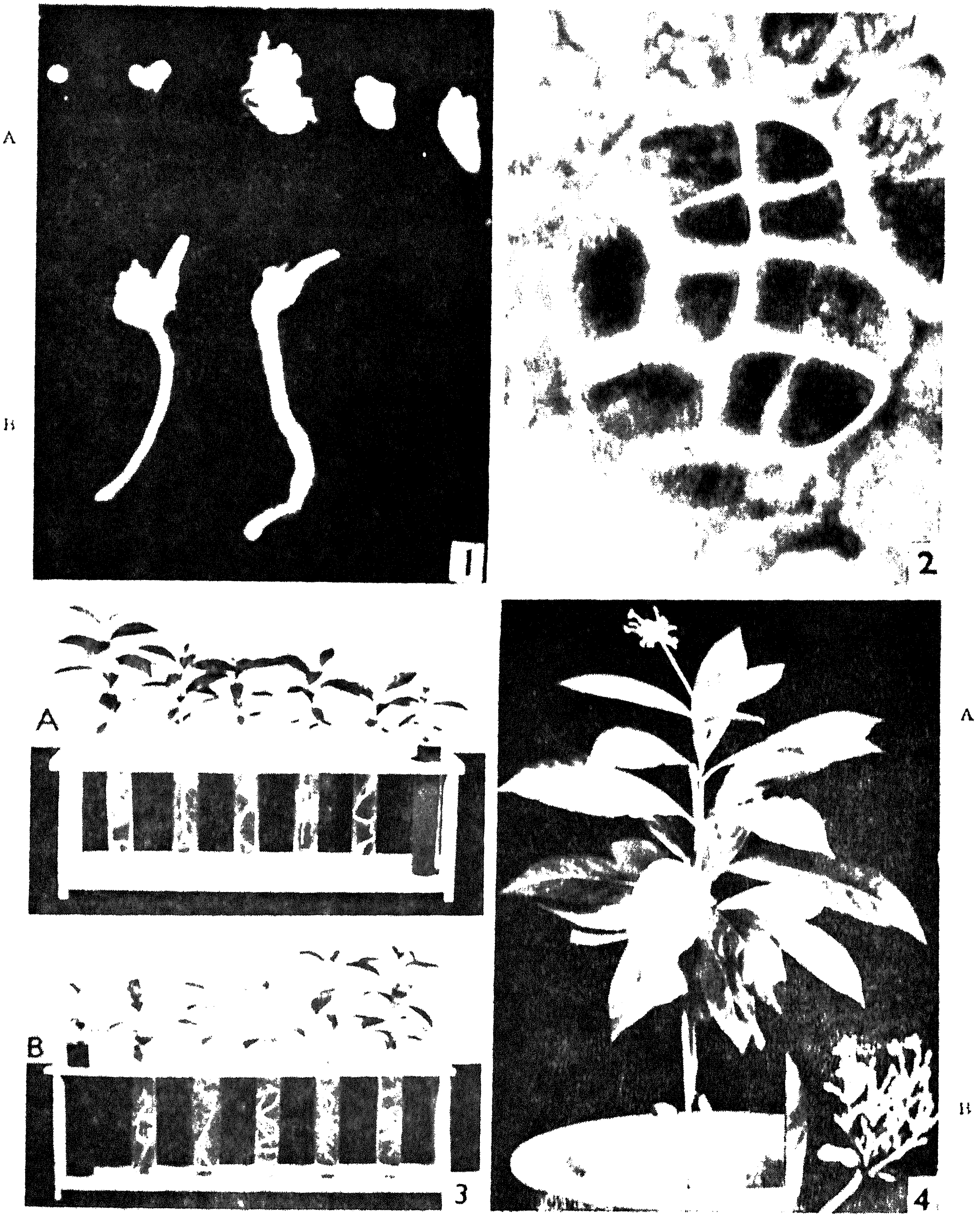
The *regenerants* on transfer to fresh nutrient agar, of the same composition, grew into plantlets. When they produced 3 to 4 pairs of leaves and a good root system was formed, they were taken out from aseptic nutrient agar cultures, washed thoroughly in running tap-water and subsequently cultured in an inorganic nutrient solution (modified Knop's solution). Plantlets regenerated from leaf callus (Fig. 3, A) and seedlings raised from cultured excised embryos (Fig. 3, B) of *R. serpentina* looked exactly similar in their root and shoot systems. The plants were later transplanted into potted soil (sand and soil 1 : 1) with added nutrient solution. Finally, the growing plants were transplanted into manured soil in pots and placed under field conditions; where they grew normally and vigorously. And in about a year's growth they, like seed-plants, produced flowers only (Fig. 4, A), but during subsequent flushes of flowering, fruits were also formed (Fig. 4, B). Thus, it is quite safe to conclude that the tissue-plants were normal in every respect.

This study has demonstrated the possibility of getting a large number of genetically identical plants from a small lump of tissue for clonal propagation of *R. serpentina* by tissue culture technique.

The authors express their sincere thanks to Dr. L. B. Singh, Director, National Botanic Gardens, for his kind interest in the present investigation.

---

1. Steward, F. C., Mapes, M. O. and Mears, K., *Amer. J. Bot.* 1958, **45,** 705.
2. —, Kent, A. E. and Holsten, *Science*, 1964, **143,** 20.
3. Vasil, V. and Hildebrandt, A. C., *Ibid.*, 1965, **158,** 889.
4. Murashige, T. and Nakano, R., *J. Heredity*, 1966, **57,** 115.
5. Nitsch, J. P. and Nitsch, C., *Science*, 1969, **163,** 85.
6. Murashige, T. and Skoog, F., *Physiol. Plant.*, 1962, **15,** 473.
7. Mitra, G. C., Prabha, C. and Chaturvedi, H. C., *Indian J. Exp. Biol.*, 1965, **3,** 216.



Figs. 1-4. Fig. 1. *Regenerants* differentiated in proembryogenic tissue. A, Embryoids at different developmental stages from globular to, more or less, torpedo. B, Young plantlets developed from bipolarized meristematic nodules (Both × 5·4). Fig. 2. A 12-celled embryoid in cross-section, differentiating in proembryogenic tissue. (× 1170). Fig. 3. Regenerated plants of *R. serpentina* growing in an inorganic nutrient solution. A, plants raised from leaf callus. B, Plants raised from excised seed embryos. (Both × 0·13 approx.). Fig. 4. A, Pot culture of 1 year old callus regenerated *R. serpentina* plant in flowering. (× 0·22 approx.) B, A magnified view of the fruit bearing inflorescence of the same plant during the second flush of flowering, (× ·45 approx.).

LETTERS TO THE EDITOR

ENANTIOMORPHISM IN HYDROGEN PEROXIDE, THE SIMPLEST DISSYMMETRIC MOLECULE*

THE X-ray analysis of the structure of hydrogen peroxide was reported by Abrahams, Collin and Limpscomb[1] and a more detailed analysis including the location of hydrogen atoms using neutron diffraction technique was reported by Busing and Levy.[3] This confirmed that the molecule is essentially non-planar with a C_2 symmetry and a dihedral angle of 89° ± 2°. The molecule of hydrogen peroxide is of considerable interest from the point of view of rotational isomerism since it may be considered to be the simplest dissymmetric molecule which can show conformational isomerism, a fact, which the author feels, is not adequately emphasized in the normal literature. It is simplest in the sense that it contains the minimum number of atoms namely four. The only other type of molecule which could compete with hydrogen peroxide is perhaps substituted ammonia namely NXYZ, where X,Y,Z are substituents all different from each other. But H_2O_2, may be considered simpler than NXYZ since, in order to show isomerism, the latter requires all the four atoms to be of different species while in the former only two species are present.

The optical inactivity of H_2O_2 at room temperature is due to the relatively small rotational energy barrier namely about 1 to 2 kcal./mole, and hence both isomers will be in equal proportions. To be able to isolate the isomers, the value of the energy barrier for rotation around single bonds, is required to be of the order of 20 kcal./mole or more.[4] It is however of interest to note in this connection that in the solid crystalline state H_2O_2 takes up the non-centrosymmetric and enantiomorphous space group[3,7] $P4_12_12$ (or $P4_32_12$) which clearly shows that only one particular species of rotamer exists in the lattice. The fact that it takes up the space group $P4_12_12$ also shows that the two enantiomeric crystalline forms should exist. A reference to literature[1,3,9] shows that no specific observation on this point seems to have been made. Crystals may also be expected to show optical activity since it is uniaxial and the oxygens have relatively large polarisability.

A further interesting aspect of its structure is the possibility of establishing the absolute configuration of the crystal structure which will yield the absolute conformation of the molecule, *i.e.*, the helical sense, and this will yield particularly valuable correlation with its optical activity in the solid state.

This possibility has been considered by us, using the X-ray anomalous dispersion technique,[2] since, recently even with light elements such as oxygen, determination of absolute configuration has been achieved successfully.[6] However, in the case of H_2O_2 the "non-anomalous scatterer" namely the hydrogen is of rather very low scattering power and the possibility of detecting the difference in intensity of the Bijvoet pairs looks rather remote. For instance using the co-ordinates of Busing and Levy[3] and using $\Delta f_0'' = 0{\cdot}028$ (Zachariasen[10]) the maximum value of the Bijvoet ratio

$$\frac{[I\,(H) - I\,(\bar{H})]}{\left[\frac{I\,(H) + I\,(\bar{H})}{2}\right]},$$

turns out to be about 1% for a few reflections. The accuracy, attainable with the available diffractometers, makes it unlikely that the effect could possibly be detected.

It may be remarked in this context that a somewhat similar case of enantiomorphism in the solid state for a dissymmetric molecule was pointed out sometime ago by Robertson[8] in the case of ammonium oxalate, where the oxalate ion in that particular structure lacks the $\bar{1}$ and *m* symmetry and the crystal takes the non-centrosymmetric space group $P2_12_12_1$. It may be noted that the oxalate ion normally has a plane of symmetry but in the particular structure mentioned above it becomes dissymmetric due to rotation of one of the COO^- planes with respect to the other around the C-C single bond resulting in a dihedral angle of about 27°. This has been attributed to the influence of the NH_4^+ ion which has a strong hydrogen bonding tendency. The case of hydrogen peroxide discussed here may be considered even simpler than the oxalate ion in ammonium oxalate since in the former the entire crystal structure is based purely on the single species of the dissymmetric molecule, not needing any other ions or groups.

Finally, it may be remarked that the possible existence of rotational isomers in disulphides and related compounds has earlier been considered,[5] and in fact some of the crystals containing such structures take up enantiomorphous space groups.[5] Although the dissymmetry in these structures is similar to that of H_2O_2, these are obviously more complex structures.

Morphological and other optical studies on H_2O_2 crystals are being undertaken and the results will be reported in due course.

I would like to thank Professor S. Swaminathan and Dr. R. Ganesan and Prof. G. N. Ramachandran for helpful discussion, and Mr. K. K. Chacko for assistance in calculations.

Centre of Advanced Study in Physics,
University of Madras,
Madras-25, India, *November* 5, 1969.

R. SRINIVASAN.

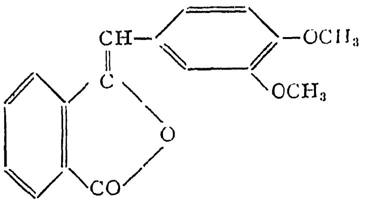
---

* Contribution No. 281 from the Centre of Advanced Study in Physics, University of Madras, Guindy Campus, Madras-25, India.

1. Abrahams, S. C., Collin, R. L. and Lipscomb, W. N., *Acta Cryst*, 1951, **4**, 15.
2. Pijvoet, J. M., Peerdeman, A. F. and Van Bommel, A. J., *Nature*, 1951, **168**, 271.
3. Busing, W. R. and Levy, H. A., *J. Chem. Phys.*, 1965, **42** 3054.
4. Eliel, E. L., *Stereochemistry of Carbon Compounds*, McGraw-Hill & Co, 1962.
5. Foss, O., *Acta Chem. Scand.*, 1954, **8**, 469.
6. Hope, H. and De La Camp, U., *Nature*, 1969, **221**, 54.
7. Linke, A. H. and Klearen, A., *Acta Cryst.*, 1968, **24 B**, 1619.
8. Robertson, J. H., *Ibid.*, 1965, **18**, 417.
9. Schumb, W. C., Satterfield, C. N. and Wentworth, R. L., *Hydrogen Peroxide*, Reinhold Publishing Company, 1955.
10. Zachariasen, W. H., *Acta Cryst.*, 1965, **18**, 714.

X-RAY CRYSTALLOGRAPHIC DATA ON VERATRILPHTHALIDE, $C_{17}H_{14}O_4$

VERATRILPHTHALIDE ($C_{17}H_{14}O_4$) with stereochemical formula (I) crystallizes as slightly elongated plates. When examined under the



(I)

polarising microscope, the crystals show straight extinction parallel to the long edge which corresponds to the crystallographic axis of 7·98 Å. The unit cell constants were determined by taking Laue, oscillation, rotation and Weissenberg photographs and were found to be for a triclinic system:

$a = 14\cdot33 \pm 0\cdot03$ Å; $b = 15\cdot30 \pm 0\cdot03$ Å; $c = 7\cdot98 \pm 0\cdot02$ Å; $\alpha = 119° 56'$; $\beta = 104° 14'$; $\gamma = 94° 36'$; $\rho_{\text{obs.}} = 1\cdot30_9$ gm./ml.; $\rho_{\text{calc.}} = 1\cdot30$ gm./ml. (for Z = number of asymmetric units in the cell = 4); Also the volume V = 1431·70 Å^3.

It is, therefore, established that in the triclinic unit cell there are four molecules present. We have ruled out the possibility of a face-centred cell (either A, B or C) from the indexing on normal and upper level Weissenberg photographs.

A powder photograph was taken on a Philips powder camera of 57·3 mm. radius. The various powder lines occurring on the photograph with their indices on the basis of the unit cell constants quoted above and their relative intensities will be found in Table I. As there are four formula units present in one unit cell, in all probability the space group is $P_{\bar{1}}$ with two formula units of $C_{17}H_{14}O_4$ forming the asymmetric unit.

No further structural work is proposed to be undertaken by us on this crystal.

TABLE I

X-ray diffraction powder data for veratrilphthalide $C_{17}H_{14}O_4$

I/I₁	d (Å)		hkl	I/I₁	d (Å)		hkl
	Obs.	Calc.			Obs.	Calc.	
9	8·347	8·355	110	12	3·379	3·372	400
6	7·621	7·570	$11\bar{1}$			3·325	320
100	6·824	6·825	$10\bar{1}$	47	3·186	3·196	$2\bar{4}0$
35	6·651	6·649	$2\bar{1}0$			3·198	040
24	6·118	6·083	$1\bar{1}1$	35	3·058	3·059	$\bar{1}31$
17	5·809	5·796	$1\bar{2}1$			3·093	$\bar{2}31$
20	5·445	5·459	210	9	2·734	2·704	131
29	5·253	5·233	101	9	2·690	2·698	500
24	5·054	5·015	$22\bar{1}$	3	2·645	2·646	$12\bar{3}$
47	4·796	4·787	$\bar{2}11$	2	2·437	2·443	231
29	4·623	4·658	$13\bar{1}$			2·423	022
		4·595	$3\bar{1}0$			2·464	$11\bar{3}$
71	4·277	4·263	030	2	2·388	2·364	$10\bar{3}$
71	4·138	4·144	111	6	2·329	2·348	$1\bar{2}3$
		4·166	$3\bar{2}0$	6	2·182	2·190	$\bar{1}32$
		4·173	$2\bar{3}1$	2	2·158	2·175	003
15	3·930	3·960	310			2·133	060
		3·907	$\bar{1}21$	3	2·044	2·045	103
47	3·781	3·788	$\bar{2}21$			2·057	$\bar{1}13$
		3·767	$13\bar{2}$	2	1·985	1·980	132
20	3·706	3·729	$1\bar{4}1$			1·975	013
		3·684	021				
29	3·489	3·491	$1\bar{2}2$				
		3·447	$1\bar{3}2$				
		3·525	$3\bar{1}1$				
		3·441	$10\bar{2}$				

Department of Physics,
University of Ranchi,
Ranchi-8, *November* 1, 1969.

M. P. GUPTA.
S. M. PRASAD.

THE BAND SPECTRUM OF GERMANIUM MONOIODIDE

WHEREAS a large number of band systems of the spectra of diatomic germanium fluoride, chloride and bromide molecules have been known, the spectrum of germanium monoiodide has not been known till recently. Oldershaw and Robinson[1] studied the absorption spectrum of germanium monoiodide employing flash photolysis technique and reported a discrete band system in the ultraviolet region. In the course of our recent investigations on the halide spectra of IVA group elements a characteristic emission band spectrum attributable to germanium monoiodide molecule has been discovered in the visible region. The spectrum has been observed by exciting a mixture of germanium metal and iodine vapours by a R.F. discharge from a ½ K.W. oscillator. The colour of the discharge is light yellow. Spectra recorded on Hilger 2-Prism Glass-Littrow and Fuess spectrographs revealed a series of red degraded bands extending from λ 6000–λ 4500. Figure 1 is the reproduction of the spectrum in the region λ 5300–λ 4500 recorded on the Fuess spectrograph. The wave-numbers of some of the prominent bands together with their vibrational assignments are shown. All these bands are analysed as belonging to a single system whose vibrational quantum formula is derived as follows:

$$\nu\ (v', v'') = 19566 \cdot 9 + 151 \cdot 2\ (v' + \tfrac{1}{2}) - 0 \cdot 44\ (v' + \tfrac{1}{2})^2 - 245 \cdot 5\ (v'' + \tfrac{1}{2}) + 0 \cdot 50\ (v'' + \tfrac{1}{2})^2.$$

The near equality of the vibrational frequency $\omega e'' = 246 \cdot 1$ cm.$^{-1}$ for the ground state as determined from the absorption work by Oldershaw and Robinson with the value $\omega e'' = 245 \cdot 5$ cm.$^{-1}$ obtained in the present work supports the view that the emitter of this visible system is the GeI molecule. For some of the bands with high v' values on the short wavelength side, the germanium isotopic effect has been detected. By analogy with similar band systems observed in the other homologues GeCl[2], GeBr[3], SiI[4] and SnI[5] molecules the transition involved in the emission of this new band system may be identified as $A\ ^2\Sigma_+ - X\ ^2\Pi_{1/2}$ of the GeI molecule.

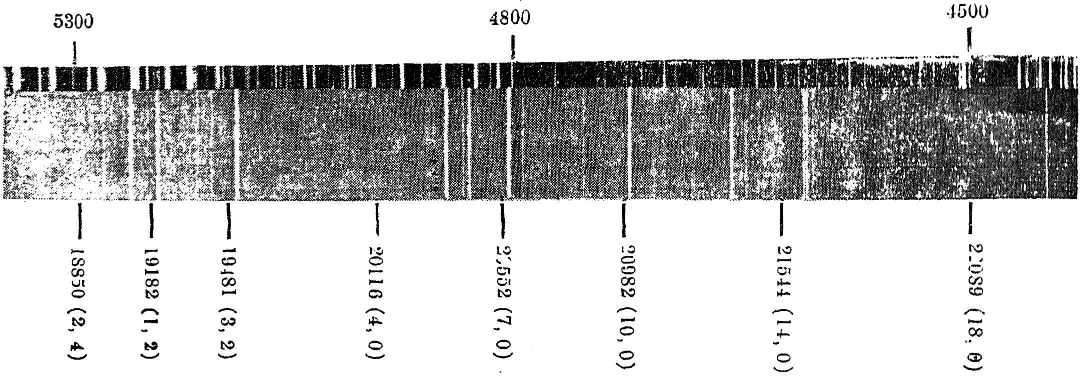


FIG. 1

Spectroscopy Lab., A. ADINARAYANA MURTY.
Physics Department, P. B. V. HARANATH.
Andhra University,
Waltair, *October* 28, 1969.

---

1. Oldershaw, G. A and Robinson, K., *Trans. Faraday Soc.*, 1968. **64**. 2256.
2. Babu Rao. K. and Haranath, P. B. V., *J. Phys. B.*, 1969, **2**, 1080.
3. — and —, *J. Phys. B.*, 1962, **2**, 1385.
4. Lakshminarayana, A. and Haranath, P. B. V., *Ibid.*, 1969, 38, 136.
5. Adinarayana Murty, A. and Haranath, P. B. V., *Ibid.*, 1969, **38**, 211.

LEAD FLUORAPATITE, $Pb_{10}\ (PO_4)_6\ F_2$

THE lead apatites are a group of inorganic compounds which can be represented by the general formula $Pb_{10}(PO_4)_6\ Z_2$ where $Z = Br^-$, Cl^-, F^- or OH^-. They have the hexagonal structure with space group $P6_3/m\,(C_{6h}^2)$.

A new method of preparing lead fluorapatite, $Pb_{10}(PO_4)_6\ F_2$, which has proved quite effective is reported here. The formation of this compound was described by Merker and Wondratschek[1] who prepared it by sintering stoichiometric amounts of lead phosphate, $Pb_3(PO_4)_2$, and lead fluoride, PbF_2, at 600° C. in platinum tubes. The unit cell dimensions were given as: $a = 9 \cdot 76$ Å, $c = 7 \cdot 29$ Å, and $c/a = 0 \cdot 746$.

The lead fluorapatite of this investigation was prepared by using stoichiometric quantities of K_2HPO_4, NaF, and $Pb(CH_3COO)_2$. All chemicals were of laboratory grade and were

used as supplied. A solution of K_2HPO_4 (1.80 gm. 100 ml.) was mixed with a solution of NaF (0.14 gm. 50 ml.). The mixed solution was added dropwise to a continuously stirred solution of $Pb(CH_3COO)_2$ (6.40 gm. 100 ml.). The temperature of the reacting mixture was held at 100° C. The stirring was continued for about 2 hours and the lead fluorapatite which had formed was removed by filtration, washed with distilled water, and dried at 100° C. The proposed reaction is shown below:

$$6K_2HPO_4 + 2NaF + 10Pb(CH_3COO)_2 \rightarrow Pb_{10}(PO_4)_6F_2 + 12CH_3COOK + 2CH_3COONa + 6CH_3COOH$$

The compound starts decomposing above 400° C, but it does not melt completely upto 1021° C. It is insoluble in water and several known solvents but very slightly dissolves in nitric acid. Analysis: calculated for $Pb_{10}(PO_4)_6F_2$; Pb, 77.32%, PO_4, 21.27%. Found: Pb, 77.25%, PO_4, 21.30%.

Infrared spectrum was run from 400 to 1200 cm.⁻¹ on Perkin-Elmer 337 Infrared spectrophotometer using KBr pellets. Major peaks in the spectrum were: 580 very strong, 560 very strong ($\nu_4 PO_4$), 985 to 1,065 very strong, broad ($\nu_3 PO_4$).

The X-ray powder diffraction pattern was taken on a CGR (France) instrument in a Seeman-Bohlin camera using CoKα radiation (λ 1.7892 Å). The powdered apatite and small amount of calcite used as an internal standard were thoroughly ground in an agate mortar and spread over a mount of polystyrene foil. The following lattice constants resulted from the cell based on the space group C_{6h}^2: a = 9.77 Å, c = 7.30 Å and c/a = 0.747. The results of measurements clearly show that the lead fluorapatite prepared by this process is identical with that synthesized by the method of Merker and Wondratschek.[1]

I thank Office National de l'Azote (France) for financial support.

Ecole Nationale Vijay Mohan Bhatnagar*
Supérieure de Chimie,
Département de Chimie Inorganique,
Chaire de Chimie-Physique,
38 rue des 36 Ponts,
Toulouse-31, France, August 11, 1969.

---

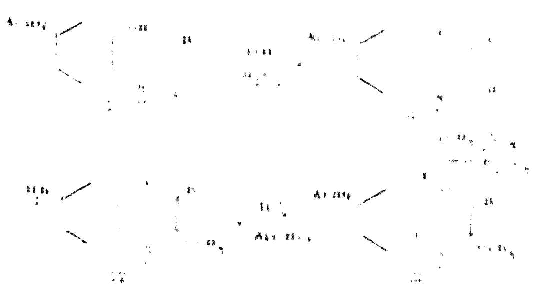
* Present Address: Department of Chemistry, The University of New Brunswick, Fredericton, New Brunswick, Canada.

1. Merker, L. and Wondratschek, H., *Z. anorg. allgem. Chem.*, 1959, 41, 300.

SYNTHESIS OF 3-METHOXY-7-AMINO FLAVONES AS POTENTIAL BACTERICIDES

Geiger and Conn[1] and Kamodia and Dua[2] have shown that α, β-unsaturated ketones exhibit bacteriostatic activity. Bacteriostatic action of α, β-unsaturated ketones has been found to increase with the introduction of halogen and hydroxy substituents.[3] Since 4-amino salicylic acid is well known for its anti-tubercular properties, 7-amino flavone was prepared and found to inhibit the growth of *Mycobacterium tuberculosis*.[4] Subsequently a number of 7-amino flavones were prepared in our laboratories and tested for their bacteriostatic activity.[5] The synthesis of amino and halogeno substituted flavonols has, therefore, been taken up with a view to test their bacteriostatic activity.

Condensation of 4-acetamino-2-hydroxy acetophenone with benzaldehyde, 2-methoxy, 2, 4-dimethoxy, 3, 4-dimethoxy, 2, 4-dichloro, and p-chloro benzaldehydes in 30% aqueous alcoholic KOH led to the formation of the corresponding chalcones (I) in 80% yield. The chalcones on subjecting to Algar Flynn Oyamada (AFO) gave the corresponding 7-acetamino-3-hydroxy flavones (II) in better yields at room temperature rather than at 0° C. The flavonols thus obtained have been methylated (III) and hydrolysed using 10% alcoholic hydrochloric acid to obtain the corresponding 7-amino-3-methoxy flavones (IV). The compounds synthesized together with their melting points are listed in Table 1.



All the compounds listed in Table 1 have been tested for their activity against *Bacillus coli*, and *Staphylococcus aureus* using the tube dilution method.[6] None of them showed activity against *S. aureus* but exhibited activity against *E. coli* at a concentration of 10,000 dilution. Of these, 2'-hydroxy-4'-acetamino chalcone and 3-hydroxy-3'-4'-dimethoxy 7-acetamino flavone were active at 1,00,000 dilution.

THE BAND SPECTRUM OF GERMANIUM MONOIODIDE

WHEREAS a large number of band systems of the spectra of diatomic germanium fluoride, chloride and bromide molecules have been known, the spectrum of germanium monoiodide has not been known till recently. Oldershaw and Robinson[1] studied the absorption spectrum of germanium monoiodide employing flash photolysis technique and reported a discrete band system in the ultraviolet region. In the course of our recent investigations on the halide spectra of IVA group elements a characteristic emission band spectrum attributable to germanium monoiodide molecule has been discovered in the visible region. The spectrum has been observed by exciting a mixture of germanium metal and iodine vapours by a R.F. discharge from a ½ K.W. oscillator. The colour of the discharge is light yellow. Spectra recorded on Hilger 2-Prism Glass-Littrow and Fuess spectrographs revealed a series of red degraded bands extending from λ 6000–λ 4500. Figure 1 is the reproduction of the spectrum in the region λ 5300–λ 4500 recorded on the Fuess spectrograph. The wave-numbers of some of the prominent bands together with their vibrational assignments are shown. All these bands are analysed as belonging to a single system whose vibrational quantum formula is derived as follows:

$$\nu\ (v', v'') = 19566 \cdot 9 + 151 \cdot 2\ (v' + \tfrac{1}{2}) - 0 \cdot 44\ (v' + \tfrac{1}{2})^2 - 245 \cdot 5\ (v'' + \tfrac{1}{2}) + 0 \cdot 50\ (v'' + \tfrac{1}{2})^2.$$

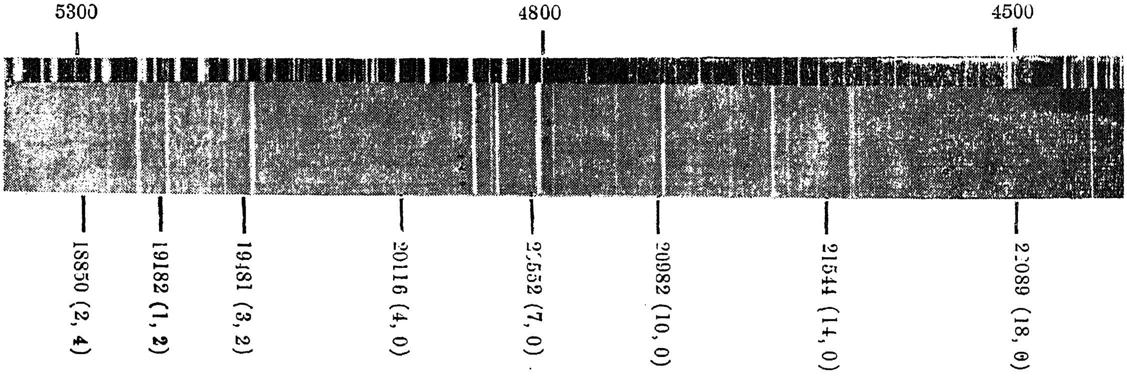


FIG. 1

The near equality of the vibrational frequency $\omega e'' = 246 \cdot 1$ cm.$^{-1}$ for the ground state as determined from the absorption work by Oldershaw and Robinson with the value $\omega e'' = 245 \cdot 5$ cm.$^{-1}$ obtained in the present work supports the view that the emitter of this visible system is the GeI molecule. For some of the bands with high v' values on the short wavelength side, the germanium isotopic effect has been detected. By analogy with similar band systems observed in the other homologues GeCl[2], GeBr[3], SiI[4] and SnI[5] molecules the transition involved in the emission of this new band system may be identified as $A\ ^2\Sigma_+ - X\ ^2\Pi_{1/2}$ of the GeI molecule.

Spectroscopy Lab., A. ADINARAYANA MURTY.
Physics Department, P. B. V. HARANATH.
Andhra University,
Waltair, *October* 28, 1969.

---

[1] Oldershaw, G. A and Robinson, K., *Trans. Faraday Soc.*, 1968. **64**. 2256.

[2] Babu Rao, K. and Haranath, P. B. V., *J. Phys. B.*, 1969, **2**, 1080.

[3] — and —, *J. Phys. B.*, 1962, **2**, 1335.

[4] Lakshminarayana, A. and Haranath, P. B. V., *Ibid.*, 1969, **38**, 136.

[5] Adinarayana Murty, A. and Haranath, P. B. V., *Ibid.*, 1969, **38**, 211.

LEAD FLUORAPATITE, $Pb_{10}\ (PO_4)_6\ F_2$

THE lead apatites are a group of inorganic compounds which can be represented by the general formula $Pb_{10}(PO_4)_6\ Z_2$ where $Z = Br^-$, Cl^-, F^- or OH^-. They have the hexagonal structure with space group $P6_3/m (C_6{}^2h)$.

A new method of preparing lead fluorapatite, $Pb_{10}(PO_4)_6\ F_2$, which has proved quite effective is reported here. The formation of this compound was described by Merker and Wondratschek[1] who prepared it by sintering stoichiometric amounts of lead phosphate, $Pb_3(PO_4)_2$, and lead fluoride, PbF_2, at 600° C. in platinum tubes. The unit cell dimensions were given as: $a = 9 \cdot 76$ Å, $c = 7 \cdot 29$ Å, and $c/a = 0 \cdot 746$.

The lead fluorapatite of this investigation was prepared by using stoichiometric quantities of K_2HPO_4, NaF, and $Pb(CH_3COO)_2$. All chemicals were of laboratory grade and were

used as supplied. A solution of K_2HPO_4 (1·80 gm./100 ml.) was mixed with a solution of NaF (0·14 gm./50 ml.). This mixed solution was added dropwise to a continuously stirred solution of $Pb(CH_3COO)_2$ (5·40 gm./100 ml.). The temperature of the reacting mixture was held at 100° C. The stirring was continued for about 2½ hours and the lead fluorapatite which had formed was removed by filtration, washed with distilled water, and dried at 100° C. The proposed reaction is shown below:

$$6K_2HPO_4 + 2\,NaF + 10\,Pb\,(CH_3COO)_2 \rightarrow Pb_{10}(PO_4)_6F_2 + 12\,CH_3\,COOK + 2\,CH_3\,COONa = 6\,CH_3\,COOH.$$

The compound starts decomposing above 400° C., but it does not melt completely upto 1021° C. It is insoluble in water and several known solvents but very slightly dissolves in nitric acid. Analysis: calculated for $Pb_{10}(PO_4)_6F_2$; Pb = 77·30%, PO_4 = 21·27%. Found: Pb = 77·25%, PO_4 = 21·10%.

Infrared spectrum was run from 400 to 1200 cm.$^{-1}$ on Perkin-Elmer 337 Infrared spectrophotometer using KBr pellets. Major peaks in the spectrum were: 530, very strong, 560 very strong ($\nu_4 PO_4^{3-}$), 935 to 1,065 very strong, broad ($\nu_3 PO_4^{3-}$).

The X-ray powder diffraction pattern was taken on a CGR (France) instrument in a Seeman-Bohlin camera using CoKα radiation (λ 1·77892 Å). The powdered apatite and small amount of calcite used as an internal standard were thoroughly ground in an agate mortar and spread over a mount of polystyrene foil. The following lattice constants resulted from the cell based on the space group $C_6{}^2h$: $a = 9{\cdot}77$ Å, $c = 7{\cdot}30$ Å and $c/a = 0{\cdot}747$. The results of measurements clearly show that the lead fluorapatite prepared by this process is identical with that synthesized by the method of Merker and Wondtratschek.[1]

I thank Office National de l' Azote (France) for financial support.

Ecole Nationale VIJAY MOHAN BHATNAGAR.*
Supérieure de Chimie,
Département de Chimie Inorganique,
Chaire de Chimie-Physique,
38 rue des 36 Ponts,
Toulouse-31, France, *August* 11, 1969.

---

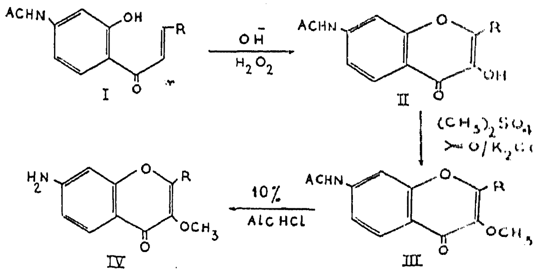
* Present Address: Department of Chemistry, The University of New Brunswick, Fredericton, New Brunswick, Canada.

1. Merker, L. and Wondratschek, H., *Z. anorg. allgem. Chem.*, **1959, 41,** 300.

SYNTHESIS OF 3-METHOXY-7-AMIN FLAVONES AS POTENTIAL BACTERICIDES

GEIGER AND CON[1] AND KAMODA AND ITO[2] ha shown that $\alpha:\beta$-unsaturated ketones exhil bacteriostatic activity. Bacteriostatic action $\alpha:\beta$-unsaturated ketones has been found increase with the introduction of halogen a hydroxy substituents.[3-5] Since 4-amino sa cylic acid is well known for its anti-tubercul properties, 7-amino flavone was prepared a found to inhibit the growth of *Mycobacteri tuberculosis*.[6] Subsequently, a number 7-amino flavones were prepared in our labor tories and tested for their bacteriostatic ac vity.[7] The synthesis of amino and haloge substituted flavonols has, therefore, been tak up with a view to test their bacteriosta activity.

Condensation of *p*-acetamino-*o*-hydro acetophenone with benzaldehyde, 2-metho 2 : 4-dimethoxy, 3 : 4-dimethoxy, 2 : 4-dichlo and *p*-chloro benzaldehydes in 30% aqueo alcoholic KOH led to the formation of the co responding chalcones (I) in 80% yield. T chalcones on subjecting to Algar-Flyn-Oxid tion (A.F.O.)[8] gave the corresponding 7-ac amino-3-hydroxy flavones (II) in better yiel at room temperature rather than at 0° C. T flavonols thus obtained have been methylat (III) and hydrolysed using 10% alcoho hydrochloric acid to obtain the correspondi 7-amino-3-methoxy flavones (IV). The co pounds synthesised together with their me ing points are listed in Table I.



All the compounds listed in Table I ha been tested for their activity against *Bacil coli*, and *Staphylococcus aureus* using the tu dilution method.[9] None of them showed ac vity against *S. aureus* but exhibited activ against *E. coli* at a concentration of 10,000 dil tion. Of these, 2′-hydroxy-4′-acetamino ch cone and 3-hydroxy-3′-4′-dimethoxy-7-ac amino flavone were active at 1,00,000 diluti

ND SPECTRUM OF GERMANIUM MONOIODIDE

a large number of band systems of ra of diatomic germanium fluoride, and bromide molecules have been ıe spectrum of germanium monoiodide ɔeen known till recently. Oldershaw ıson[1] studied the absorption spectrum ınium monoiodide employing flash technique and reported a discrete ɜm in the ultraviolet region. In the our recent investigations on the ɪectra of IVA group elements a ɜtic emission band spectrum attri- germanium monoiodide molecule has overed in the visible region. The has been observed by exciting a of germanium metal and iodine ɪy a R.F. discharge from a ½ K.W. The colour of the discharge is light Spectra recorded on Hilger 2-Prism row and Fuess spectrographs revealed f red degraded bands extending from ɪ00. Figure 1 is the reproduction of ım in the region λ 5300–λ 4500 recorded uess spectrograph. The wave-num- ıme of the prominent bands together vibrational assignments are shown. bands are analysed as belonging to a stem whose vibrational quantum derived as follows :

$$') = 19566 \cdot 9 + 151 \cdot 2 \quad (v' + \tfrac{1}{2}) - 0 \cdot 44 \, (v' + \tfrac{1}{2})^2 - 245 \cdot 5 \, (v'' + \tfrac{1}{2}) + 0 \cdot 50 \, (v'' + \tfrac{1}{2})^2.$$

r equality of the vibrational frequency 1 cm.$^{-1}$ for the ground state as deter- n the absorption work by Oldershaw son with the value $\omega e'' = 245 \cdot 5$ cm.$^{-1}$ ı the present work supports the view ɜmitter of this visible system is the GeI molecule. For some of the bands with high v' values on the short wavelength side, the germanium isotopic effect has been detected. By analogy with similar band systems observed in the other homologues GeCl[2], GeBr[3], SiI[4] and SnI[5] molecules the transition involved in the emission of this new band system may be identified as $A\ ^2\Sigma_+ - X\ ^2\Pi_{1/2}$ of the GeI molecule.

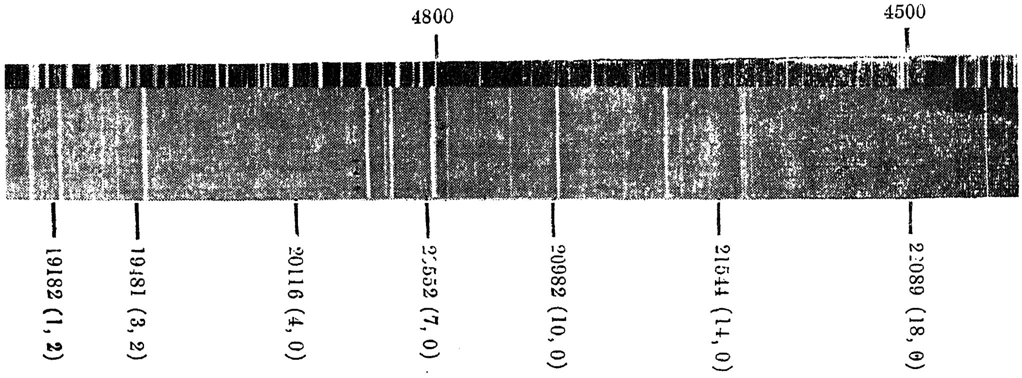


FIG. 1

Spectroscopy Lab.,
Physics Department,
Andhra University,
Waltair, *October* 28, 1969.

A. Adinarayana Murty.
P. B. V. Haranath.

---

1. Oldershaw, G. A and Robinson, K., *Trans. Faraday Soc.*, 1968, **64**, 2256.
2. Babu Rao, K. and Haranath, P. B. V., *J. Phys. B.*, 1969, **2**, 1080.
3. — and —, *J. Phys. B.*, 1962, **2**, 1335.
4. Lakshminarayana, A. and Haranath, P. B. V., *Ibid.*, 1969, **38**, 136.
5. Adinarayana Murty, A. and Haranath, P. B. V., *Ibid.*, 1969, **38**, 211.

LEAD FLUORAPATITE, $Pb_{10}(PO_4)_6F_2$

The lead apatites are a group of inorganic compounds which can be represented by the general formula $Pb_{10}(PO_4)_6Z_2$ where Z = Br$^-$, Cl$^-$, F$^-$ or OH$^-$. They have the hexagonal structure with space group $P6_3/m\,(C_6{}^2h)$.

A new method of preparing lead fluorapatite, $Pb_{10}(PO_4)_6F_2$, which has proved quite effective is reported here. The formation of this compound was described by Merker and Wondratschek[1] who prepared it by sintering stoichiometric amounts of lead phosphate, $Pb_3(PO_4)_2$, and lead fluoride, PbF_2, at 600° C. in platinum tubes. The unit cell dimensions were given as: $a = 9 \cdot 76$ Å, $c = 7 \cdot 29$ Å, and $c/a = 0 \cdot 746$.

The lead fluorapatite of this investigation was prepared by using stoichiometric quantities of K_2HPO_4, NaF, and $Pb(CH_3COO)_2$. All chemicals were of laboratory grade and were used as su (1·80 gm./10 of NaF (0·1 tion was a stirred solu 100 ml.). T mixture was continued f fluorapatite filtration, w dried at 1(shown below

$6K_2HPO_4$
$Pb_{10}(PO_4$
COONa =

The com 400° C., but 1021° C. It known solve nitric acid. F_2; Pb = Pb = 77·25%

Infrared 1200 cm.$^{-1}$ spectrophoto peaks in the 560 very st strong, broa

The X-ra taken on a Seeman-Boh (λ 1·77892 Å small amou standard we mortar and foil. The from the ce $a = 9 \cdot 77$ Å, results of n lead fluora identical wi of Merker

I thank C for financia

Ecole Natio
Supérieur
Départemen
Chaire de C
38 rue des
Toulouse-31

---

* Present Ad versity of Ne Canada.

1, Merker, *Chem.*

used as supplied. A solution of K_2HPO_4 (1·80 gm./100 ml.) was mixed with a solution of NaF (0·14 gm./50 ml.). This mixed solution was added dropwise to a continuously stirred solution of $Pb(CH_3COO)_2$ (5·40 gm./100 ml.). The temperature of the reacting mixture was held at 100° C. The stirring was continued for about 2½ hours and the lead fluorapatite which had formed was removed by filtration, washed with distilled water, and dried at 100° C. The proposed reaction is shown below :

$$6K_2HPO_4 + 2\,NaF + 10\,Pb\,(CH_3COO)_2 \rightarrow Pb_{10}(PO_4)_6F_2 + 12\,CH_3\,COOK + 2\,CH_3\,COONa = 6\,CH_3\,COOH.$$

The compound starts decomposing above 400° C., but it does not melt completely upto 1021° C. It is insoluble in water and several known solvents but very slightly dissolves in nitric acid. Analysis : calculated for $Pb_{10}(PO_4)_6F_2$; Pb = 77·30%, PO_4 = 21·27%. Found : Pb = 77·25%, PO_4 = 21·10%.

Infrared spectrum was run from 400 to 1200 cm.$^{-1}$ on Perkin-Elmer 337 Infrared spectrophotometer using KBr pellets. Major peaks in the spectrum were : 530, very strong, 560 very strong ($\nu_4 PO_4{}^{3-}$), 935 to 1,065 very strong, broad ($\nu_3 PO_4{}^{3-}$).

The X-ray powder diffraction pattern was taken on a CGR (France) instrument in a Seeman-Bohlin camera using CoKα radiation (λ 1·77892 Å). The powdered apatite and small amount of calcite used as an internal standard were thoroughly ground in an agate mortar and spread over a mount of polystyrene foil. The following lattice constants resulted from the cell based on the space group $C_6{}^2h$: $a = 9{\cdot}77$ Å, $c = 7{\cdot}30$ Å and $c/a = 0{\cdot}747$. The results of measurements clearly show that the lead fluorapatite prepared by this process is identical with that synthesized by the method of Merker and Wondtratschek.[1]

I thank Office National de l' Azote (France) for financial support.

Ecole Nationale Supérieure de Chimie, VIJAY MOHAN BHATNAGAR.*
Département de Chimie Inorganique,
Chaire de Chimie-Physique,
38 rue des 36 Ponts,
Toulouse-31, France, *August* 11, 1969.

---

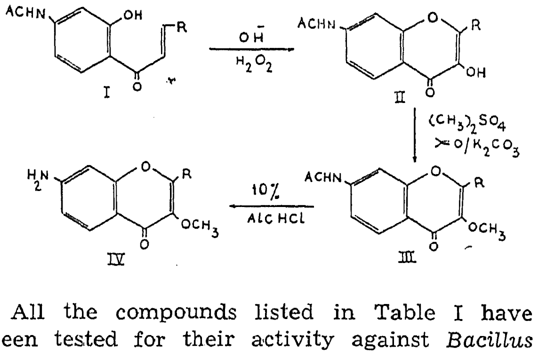
* Present Address : Department of Chemistry, The University of New Brunswick, Fredericton, New Brunswick, Canada.

1. Merker, L. and Wondratschek, H., *Z. anorg. allgem. Chem.*, 1959, **41**, 300.

SYNTHESIS OF 3-METHOXY-7-AMINO FLAVONES AS POTENTIAL BACTERICIDES

GEIGER AND CON[1] AND KAMODA AND ITO[2] have shown that $\alpha:\beta$-unsaturated ketones exhibit bacteriostatic activity. Bacteriostatic action of $\alpha:\beta$-unsaturated ketones has been found to increase with the introduction of halogen and hydroxy substituents.[3-5] Since 4-amino salicylic acid is well known for its anti-tubercular properties, 7-amino flavone was prepared and found to inhibit the growth of *Mycobacterium tuberculosis*.[6] Subsequently, a number of 7-amino flavones were prepared in our laboratories and tested for their bacteriostatic activity.[7] The synthesis of amino and halogeno substituted flavonols has, therefore, been taken up with a view to test their bacteriostatic activity.

Condensation of p-acetamino-o-hydroxy acetophenone with benzaldehyde, 2-methoxy, 2 : 4-dimethoxy, 3 : 4-dimethoxy, 2 : 4-dichloro, and p-chloro benzaldehydes in 30% aqueous alcoholic KOH led to the formation of the corresponding chalcones (I) in 80% yield. The chalcones on subjecting to Algar-Flyn-Oxidation (A.F.O.)[8] gave the corresponding 7-acetamino-3-hydroxy flavones (II) in better yields at room temperature rather than at 0° C. The flavonols thus obtained have been methylated (III) and hydrolysed using 10% alcoholic hydrochloric acid to obtain the corresponding 7-amino-3-methoxy flavones (IV). The compounds synthesised together with their melting points are listed in Table I.



All the compounds listed in Table I have been tested for their activity against *Bacillus coli*, and *Staphylococcus aureus* using the tube dilution method.[9] None of them showed activity against *S. aureus* but exhibited activity against *E. coli* at a concentration of 10,000 dilution. Of these, 2′-hydroxy-4′-acetamino chalcone and 3-hydroxy-3′-4′-dimethoxy-7-acetamino flavone were active at 1,00,000 dilution,

THE BAND SPECTRUM OF GERMANIUM MONOIODIDE

WHEREAS a large number of band systems of the spectra of diatomic germanium fluoride, chloride and bromide molecules have been known, the spectrum of germanium monoiodide has not been known till recently. Oldershaw and Robinson[1] studied the absorption spectrum of germanium monoiodide employing flash photolysis technique and reported a discrete band system in the ultraviolet region. In the course of our recent investigations on the halide spectra of IVA group elements a characteristic emission band spectrum attributable to germanium monoiodide molecule has been discovered in the visible region. The spectrum has been observed by exciting a mixture of germanium metal and iodine vapours by a R.F. discharge from a ½ K.W. oscillator. The colour of the discharge is light yellow. Spectra recorded on Hilger 2-Prism Glass-Littrow and Fuess spectrographs revealed a series of red degraded bands extending from λ 6000–λ 4500. Figure 1 is the reproduction of the spectrum in the region λ 5300–λ 4500 recorded on the Fuess spectrograph. The wave-numbers of some of the prominent bands together with their vibrational assignments are shown. All these bands are analysed as belonging to a single system whose vibrational quantum formula is derived as follows:

$$\nu\ (v', v'') = 19566\cdot9 + 151\cdot2\ (v'+\tfrac{1}{2}) - 0\cdot44\ (v'+\tfrac{1}{2})^2 - 245\cdot5\ (v''+\tfrac{1}{2}) + 0\cdot50\ (v''+\tfrac{1}{2})^2.$$

The near equality of the vibrational frequency $\omega e'' = 246\cdot1$ cm.$^{-1}$ for the ground state as determined from the absorption work by Oldershaw and Robinson with the value $\omega e'' = 245\cdot5$ cm.$^{-1}$ obtained in the present work supports the view that the emitter of this visible system is the GeI molecule. For some of the bands with high v' values on the short wavelength side, the germanium isotopic effect has been detected. By analogy with similar band systems observed in the other homologues GeCl[2], GeBr[3], SiI[4] and SnI[5] molecules the transition involved in the emission of this new band system may be identified as $A\ {}^2\Sigma_+ - X\ {}^2\Pi_{1/2}$ of the GeI molecule.

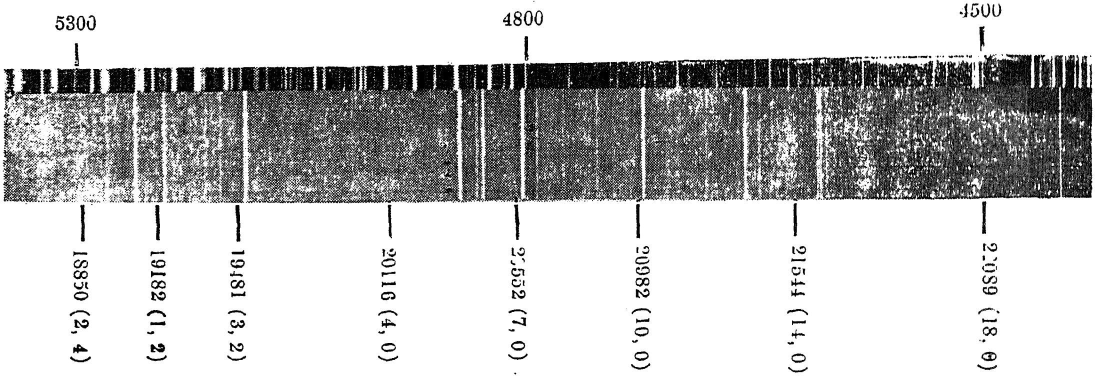


FIG. 1

Spectroscopy Lab., A. ADINARAYANA MURTY.
Physics Department, P. B. V. HARANATH.
Andhra University,
Waltair, October 28, 1969.

---

1. Oldershaw, G. A and Robinson, K., *Trans. Faraday Soc.*, 1968, **64**, 2256.
2. Babu Rao, K. and Haranath, P. B. V., *J. Phys. B.*, 1969, **2**, 1080.
3. — and —, *J. Phys. B.*, 1962, **2**, 1385.
4. Lakshminarayana, A. and Haranath, P. B. V., *Ibid.*, 1969, **38**, 136.
5. Adinarayana Murty, A. and Haranath, P. B. V., *Ibid.*, 1969, **38**, 211.

LEAD FLUORAPATITE, $Pb_{10}\ (PO_4)_6\ F_2$

THE lead apatites are a group of inorganic compounds which can be represented by the general formula $Pb_{10}(PO_4)_6\ Z_2$ where $Z = Br^-$, Cl^-, F^- or OH^-. They have the hexagonal structure with space group $P6_3/m\,(C_6{}^2h)$.

A new method of preparing lead fluorapatite, $Pb_{10}(PO_4)_6\ F_2$, which has proved quite effective is reported here. The formation of this compound was described by Merker and Wondratschek[1] who prepared it by sintering stoichiometric amounts of lead phosphate, $Pb_3(PO_4)_2$, and lead fluoride, PbF_2, at 600° C. in platinum tubes. The unit cell dimensions were given as: $a = 9\cdot76$ Å, $c = 7\cdot29$ Å, and $c/a = 0\cdot746$.

The lead fluorapatite of this investigation was prepared by using stoichiometric quantities of K_2HPO_4, NaF, and $Pb(CH_3COO)_2$. All chemicals were of laboratory grade and were

used as supplied. A solution of K_2HPO_4 (1·80 gm./100 ml.) was mixed with a solution of NaF (0·14 gm./50 ml.). This mixed solution was added dropwise to a continuously stirred solution of $Pb(CH_3COO)_2$ (5·40 gm./100 ml.). The temperature of the reacting mixture was held at 100° C. The stirring was continued for about 2½ hours and the lead fluorapatite which had formed was removed by filtration, washed with distilled water, and dried at 100° C. The proposed reaction is shown below:

$$6K_2HPO_4 + 2\,NaF + 10\,Pb\,(CH_3COO)_2 \rightarrow Pb_{10}(PO_4)_6F_2 + 12\,CH_3\,COOK + 2\,CH_3\,COONa = 6\,CH_3\,COOH.$$

The compound starts decomposing above 400° C., but it does not melt completely upto 1021° C. It is insoluble in water and several known solvents but very slightly dissolves in nitric acid. Analysis: calculated for $Pb_{10}(PO_4)_6F_2$; Pb = 77·30%, PO_4 = 21·27%. Found: Pb = 77·25%, PO_4 = 21·10%.

Infrared spectrum was run from 400 to 1200 cm.$^{-1}$ on Perkin-Elmer 337 Infrared spectrophotometer using KBr pellets. Major peaks in the spectrum were: 530, very strong, 560 very strong ($\nu_4 PO_4^{3-}$), 935 to 1,065 very strong, broad ($\nu_3 PO_4^{3-}$).

The X-ray powder diffraction pattern was taken on a CGR (France) instrument in a Seeman-Bohlin camera using CoKα radiation (λ 1·77892 Å). The powdered apatite and small amount of calcite used as an internal standard were thoroughly ground in an agate mortar and spread over a mount of polystyrene foil. The following lattice constants resulted from the cell based on the space group $C_6{}^2h$: $a = 9{\cdot}77$ Å, $c = 7{\cdot}30$ Å and $c/a = 0{\cdot}747$. The results of measurements clearly show that the lead fluorapatite prepared by this process is identical with that synthesized by the method of Merker and Wondtratschek.[1]

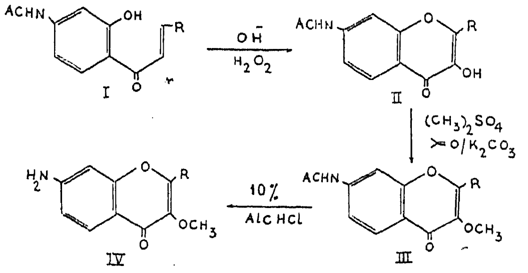
I thank Office National de l' Azote (France) for financial support.

Ecole Nationale VIJAY MOHAN BHATNAGAR.*
Supérieure de Chimie,
Département de Chimie Inorganique,
Chaire de Chimie-Physique,
38 rue des 36 Ponts,
Toulouse-31, France, *August* 11, 1969.

SYNTHESIS OF 3-METHOXY-7-AMINO FLAVONES AS POTENTIAL BACTERICIDES

GEIGER AND CON[1] AND KAMODA AND ITO[2] have shown that α : β-unsaturated ketones exhibit bacteriostatic activity. Bacteriostatic action of α : β-unsaturated ketones has been found to increase with the introduction of halogen and hydroxy substituents.[3-5] Since 4-amino salicylic acid is well known for its anti-tubercular properties, 7-amino flavone was prepared and found to inhibit the growth of *Mycobacterium tuberculosis*.[6] Subsequently, a number of 7-amino flavones were prepared in our laboratories and tested for their bacteriostatic activity.[7] The synthesis of amino and halogeno substituted flavonols has, therefore, been taken up with a view to test their bacteriostatic activity.

Condensation of *p*-acetamino-*o*-hydroxy acetophenone with benzaldehyde, 2-methoxy, 2 : 4-dimethoxy, 3 : 4-dimethoxy, 2 : 4-dichloro, and *p*-chloro benzaldehydes in 30% aqueous alcoholic KOH led to the formation of the corresponding chalcones (I) in 80% yield. The chalcones on subjecting to Algar-Flyn-Oxidation (A.F.O.)[8] gave the corresponding 7-acetamino-3-hydroxy flavones (II) in better yields at room temperature rather than at 0° C. The flavonols thus obtained have been methylated (III) and hydrolysed using 10% alcoholic hydrochloric acid to obtain the corresponding 7-amino-3-methoxy flavones (IV). The compounds synthesised together with their melting points are listed in Table I.



All the compounds listed in Table I have been tested for their activity against *Bacillus coli*, and *Staphylococcus aureus* using the tube dilution method.[9] None of them showed activity against *S. aureus* but exhibited activity against *E. coli* at a concentration of 10,000 dilution. Of these, 2′-hydroxy-4′-acetamino chalcone and 3-hydroxy-3′-4′-dimethoxy-7-acetamino flavone were active at 1,00,000 dilution.

---

* Present Address: Department of Chemistry, The University of New Brunswick, Fredericton, New Brunswick, Canada.

1. Merker, L. and Wondratschek, H., *Z. anorg. allgem. Chem.*, 1959, **41**, 300.

TABLE I

R	M.P.° C. Chalcone I	M.P.° C. Flavonol II	M.P.° C. Methyl ether III	M.P.° C. Amino flavonol IV
1. C_6H_5– ..	188-9[10]	248–9[11]	197-8	186
2. 2-MeO.C_6H_4– ..	202	175–6	152	198- 9
3. 2-4.$(MeO)_2.C_6H_3$-	182	236	200	201
4. 3-4 $(MeO)_2C_6H_3$-	167	226-7	197	218–19
5. 4-Cl.C_6H_4- ..	175	268	132	185
6. 2 : 4-$(Cl)_2.C_6H_3$-	225	274 5	208	176

One of the authors (P. N. S.) is grateful to the Council of Scientific and Industrial Research for the award of a Junior Research Fellowship.

Dept. of Chemistry, Osmania University, Hyderabad-7 (A.P.), *October* 24, 1969.
P. N. SARMA.
G. SRIMANNARAYANA.
N. V. SUBBA RAO.

---

1. Geiger, W. S. and Con, J. E., *J. Am. Chem. Soc.*, 1945, **67**, 112.
2. Kamoda, M. and Ito, N., *Chem. Abstr.*, 1945, **49**, 5572.
3. Schraufstatter, E. and Deutsch, S., *Z. Naturforsch.*, 1948, **36**, **163**, 430.
4. Agasimuddin, Y. S., Jolad, S. D. and Rajagopal, S., *Indian J. Chem.*, 1965, **3**, **220**.
5. Ambekar, S. Y., Dandegaonkar, S. H., Jolad, S. D. and Rajagopal, S., *J. Ind. Chem. Soc.*, 1963, **40**, **1041**.
6. Bapat, D. S. and Venkataraman, K., *Proc. Ind. Acad. Sci.*, 1955, **42 A**, 336.
7. Vijayalakshmi, M. and Subba Rao, N. V., *Curr. Sci.*, 1967, 36 (15), 401.
8. Algar, J. and Flynn, J. P., *Proc. Roy. Irish. Acid.*, 1934, **42 B**, **1**.
9. Morley, *J. Path. Bact.*, 1945, **57**, 379.
10. Akira Kasahara, *Nippon Kagaku Zasshi*, 1955, **76**, 535.
11. Ludwig Reichel and Gerhard Hemdel, *Ann.*, 1959, **625**, **184**.

CHEMICAL EXAMINATION OF *CYRTANTHES MACKENII* AND *CO-OPERANTHES* HYBRID

FRESH bulbs of *Cyrtanthes mackenii* and *Cooperanthes* hybrid (a hybrid between *Cooperia* and *Zephyranthes*) (N. O. *Amaryllidaceæ*), obtained from a Nursery in North India, have been chemically examined to isolate the active crystalline principles. The method of extraction was the same in both cases. The minced bulbs (2 kg.) were completely extracted with alcohol and the extract was concentrated to a small bulk and was suspended in water.

The aqueous suspension was adjusted, in both cases, to pH 6 and was extracted with ether and chloroform. The residues from these extracts did not give any crystalline substance and hence were discarded. The remaining aqueous suspension was made alkaline (pH 8) and was again extracted with chloroform and chloroform-alcohol (2 : 1).

Cyrtanthes mackenii.—A small amount of crystalline substance was obtained from these latter two extracts, m.p. 258–60° (decomp.). The mother liquors did not give any crystalline substance even after separation into neutral and phenolic fractions and chromatography over alumina.

The crystalline substance after recrystallisation from chloroform-alcohol (1 : 1) gave refracting prisms, m.p. 260–62° (decomp.). The substance answered all tests for alkaloids and has a methylene dioxy group.

$(\alpha)_D^{29} = -100 \cdot 5° \pm 2°$ (alcohol) and analysed for $C_{16}H_{17}NO_4$ (lycorine).

The picrate was prepared as usual and was crystallised from methanol when yellow shining plates were obtained, m.p. 200–02° (d.) (Reported values for m.p. of lycorine picrate, 198–200°[1] (d.) and 200–202° (d.).[2] The compound analysed for $C_{22}H_{20}N_4O_{11}$.

The acetate was prepared as usual and the residue was crystallised from alcohol when stout needles were obtained, m.p. 212–14°.

$(\alpha)_D^{29} = +25 \cdot 6° \pm 2°$ (chloroform) and analysis agreed for the formula $C_{20}H_{21}NO_6$ (lycorine diacetate).

Cooperanthes Hybrid.—When the same method of working up of the aqueous suspension was followed here also, a crystalline substance was obtained from the chloroform and chloroform-alcohol (2 : 1) extracts at pH 8. The substance answered all tests for alkaloids and has a methylene dioxy group. The compound was obtained as refracting prisms from chloroform-alcohol (1 : 1), m.p. 262–64° (d.).

$(\alpha)_D^{29} = -101 \cdot 2° \pm 2°$ (alcohol) and analysis agreed with the formula $C_{16}H_{17}NO_4$ (lycorine).

The picrate was obtained as shining yellow plates, m.p. 200–02° (d.) and analysed for $C_{22}H_{20}N_4O_{11}$.

The acetate when prepared on usual lines crystallised from methonol-ether, m.p. 214–16° $(\alpha)_D^{29} = +24 \cdot 8° \pm 2°$ (chloroform). The formula $C_{20}H_{21}NO_6$ agreed well with analysis.

The properties of the crystalline substances and their derivatives correspond well with those reported in literature for lycorine and its derivatives. A mixed m.p. of these acetates, separately, with that of authentic lycorine diacetate[3] was undepressed, Thus the indentity of the crystalline substance of the above two sources was established as lycorine. Many hybrid varieties of Amaryllidaceæ were reported to contain more than one alkaloid and it is unique that this *Co-operanthes* hybrid contains lycorine only while the reported *Zephyranthes* species and *Cooperia* contain more than one alkaloid.

Dept. of Pharmacy, R. V. KRISHNA RAO.
Andhra University,
Waltair, *October* 16, 1969.

---

1. Krishna Rao, R. V., *Ind. J. Pharm.*, 1969, **31**, 2, 62. 63.
2. Rangaswamy, S. and Venkata Rao, E., *Curr. Sci.*, 1954, **23**, 265.
3. — and Krishna Rao, R. V., *Tetrahedron Letters*, 1966, **37**, 4481.

METHOD FOR RAPID IDENTIFICATION OF *NOCARDIA*

THE genus *Nocardia* was initially characterised on the basis of morphological characters[1] but nevertheless recent investigations of Gordon and Smith[2] and Gordon and Mihm[3-6] have shown biochemical properties to be more significant and dependable for their classification and identification. In the list of multiple tests recommended by Gordon and Mihm, major stress has been paid on the decomposition of casein, tyrosine and xanthine. The development and use of biochemical methods for identification of *Nocardia* have greatly facilitated the diagnostic and ecological studies.

During our studies on the incidence of *Nocardia* associated with bronchopulmonary disorders, we modified the tests for the decomposition of casein, tyrosine and xanthine and obtained clear results after 4 days. Medium with the following composition was prepared for casein decomposition. Vitamin-free casein 10 gm., agar 20 gm., distilled water 1000 ml. The casein was initially dissolved in N/10 alcoholic KOH solution, thereafter mixed with agar in distilled water and the volume made upto 1000 ml. Medium was autoclaved at 12 lb. for 15 minutes after adjusting the pH at 7·0. Plates of this medium when inoculated and incubated at 37° C. showed clearing around the inoculum after 2 days in case of casein positive strains.

For tyrosine and xanthine decomposition 0·5% solutions of these were used. One ml. of the 0·5% sterile solution (tyrosine or xanthine) was added to 1 ml. of sterile Sorensen's phosphate buffer pH 7·0, the final 2 ml. solution was inoculated with the suspected strain of *Nocardia* and incubated at 37° C. A parallel control of 2 ml. of buffer pH 7·0 inoculated with the suspected strains was always run. After 4 days, 8 ml. of sterile distilled water and 2 ml. of Nessler's reagent were added to each tube. The development of a deeper yellow colour than the control indicated the positive whereas a colour lighter or similar to the control a negative result for the decomposition of tyrosine and xanthine.

Repeated tests for the decomposition of casein, tyrosine and xanthine performed with 35 strains of *Nocardia asteroides*, *N. brasiliensis*, *N. caviæ*, *Nocardia* spp. and *Streptomyces* spp. with the described method along with that of Gordon and Mihm's gave identical results. Results demonstrate efficacy of the method with definite advantage of obtaining rapid, clear-cut readings using media much simpler to handle and prepare.

We thank the I.C.M.R. for financial aid and Miss Sulaksh Sharma for technical assistance.

Microbiology Division, S. K. SHOME.
National Institute of N. G. S. RAGHAVAN.
Communicable Diseases,
22, Alipore Road, Delhi-6,
October 21, 1969.

---

1. *Bergey's Manual of Determinative Bacteriology*, 7th Ed., William and Wilkins, Baltimore.
2. Gordon, Ruth, E. and Smith, M. M., *J. Bact.*, 1955, **69**, 147.
3. —, — and Mihm, Joan, M., *Ibid.*, 1957, **73**, 15.
4. —, — and —, *J. Gen. Microbiol.*, 1959, **20**, 129.
5. —, — and —, *Ibid.*, 1962, **27**, 1.
6. —, — and —, *Ann. N.Y. Acad. Sci.*, 1962 *a*, **98**, 629.

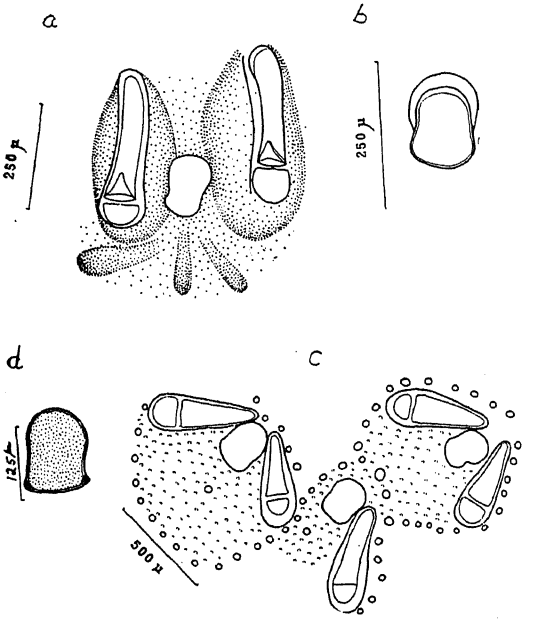
THREE SPECIES OF THE GENUS *TREMOGASTERINA* CANU (ECTOPROCTA) FROM THE INDIAN OCEAN

THREE species of *Tremogasterina* Canu 1911,[1] recorded from the Arabian Sea and the Bay of Bengal at present, were previously collected only from the Gulf of Mexico and the South Atlantic. The different species of the genus have been observed at all depths from 10 m. to 448 m. This bathymetric disposition has as a corollary a geographic distribution. This genus has been observed in the Atlantic, in the Pacific and in the China sea. In the northern hemisphere it does not go beyond the thirty-first parallel and it is therefore, a tropical genus. *Tremogasterina granulata* Canu and Bassler,[2] *T. lanceolata* Canu and Bassler were found

epizoic on corals collected from the Gulf of Mannar and *T. ventricosa* Canu and Bassler epizoic on gastropod shells dredged from the Arabian Sea.

Members of this genus are characterised by an olscyst surmounted by a rugose, pleurocyst, centrally placed reniform pores, each zooecium separated by inter-junctural pores, three to five hollow peristomial spines and hyperstomial ovicells closed by the chitinised operculum.

1. *Tremogasterina granulata* CANU AND BASSLER, 1928 (FIG. 1, *a*–*b*)



FIGS. 1, *a–b*. Fig. *a*. *Tremogasterina granulata* Canu Bassler Single zooecium; Fig. *b*. Operculum; Fig. *c*. *T. ventricosa* Canu and Bassler Two zooecia; Fig. *d*. Operculum.

Salient features.—Encrusting. Distinct, elongate, elevate zooecia separated by small pores, which may be inconspicuous. Highly calcified and granulated front with a pore in the middle (Fig. 1, *a*). Elongate and sub-orbicular orifice with a concave border. Two cardelles present. Operculum chitinous with a continuous sclerite (Fig. 1, *b*). Large avicularia, placed on calcareous thickenings on either side of the orifice, directed distally. Mandibles long with slightly pointed ends. Three small oral spines present in juvenile zooecia. Length 500 µ and breadth 540 µ.

Remarks.—Calcification owing to age will give the colonies very complicated appearance and the front will be provided with ridges and grooves.

2. *Tremogasterina ventricosa* CANU AND BASSLER, 1928 (FIG. 1, *c*–*d*)

Salient features.—Zoarium encrusting. Young zooecia distinct, separated by interjunctural pores, which get obscured as a result of calcification. Convex front tuberculated with small reniform pores (Fig. 1, *c*). Aperture elongate oval. Thin peristome with three spines. Avicularia large with rounded tips. Mandible with a sub-marginal sclerite (Fig. 1, *d*). Ovicells not noticed. Length 500 µ and breadth 420 µ.

Remarks.—Only a few zooecia in the present instance have mucros, which are inconspicuous. Discussing, the range of variation in this species Canu and Bassler[2] state that the mucro is inconsistent and may often be wanting. The number of frontal pores vary from one zooecium to another, the beak of the avicularium may be pointed or rounded.

3. *Tremogasterina lanceolata* CANU AND BASSLE, 1928 (FIG. 2, *e*–*h*)

Salient features.—Zoarium encrusting, multilaminar. Distinct zooecia separated by a line of interjunctural pores (Fig. 2, *e*). Convex front provided with very small granulations. A median pore present. Cardelles small. Large anter and rather small poster. Chitinised, elongated oval operculum with a thin marginal sclerite. Avicularia large, often paired, usually pointed distally or rarely disto-medianly. Immersed ovicells tuberculated, often with a few large tubercles (Fig. 2, *g*). Ovicells closed by the operculum. Length 750 µ and breadth 625 µ.

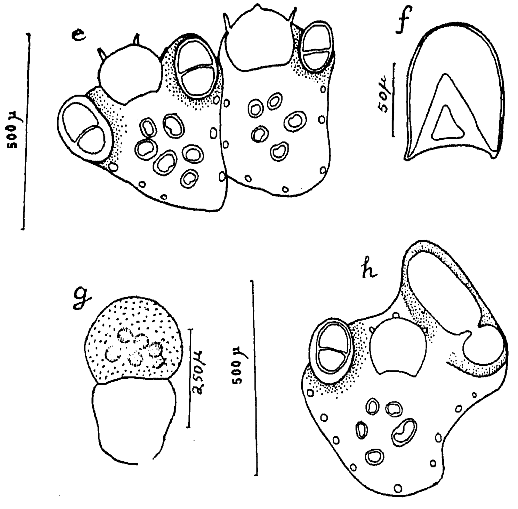


FIG. 2. *e–h*. *Tremogasterina lanceolata*. Fig. *e*, Two zooecia; Fig. *f*. Avicularian mandible; Fig. *g*. Ovicell. Adventitious avicularia,

[illegible]

Bharati [illegible]

Zoological [illegible]

[illegible]

[illegible]

The Marine [illegible]

Zoological [illegible]

University of Kerala,

Trivandrum [illegible]

1. [illegible], **1(1)** 21, [illegible]
2. [illegible], 1928, **72**, 11-15.

A DILEPIDID CYSTICERCOID FROM *UROMASTIX HARDWICKII* AND ITS EXPERIMENTAL DEVELOPMENT IN PUP

Genus *J*[illegible] Fuhrmann, [illegible] (= *Joyeuxia* Lopez-Neyra, 1927), [illegible] parasites of carnivorous mammals, *J. [illegible]* is genotype and [illegible] other species have been [illegible] Tenora? has [illegible] the species, *J. [illegible]*. Recognising the species [illegible] by [illegible], Mettrick and Beverley-Burton [illegible] described a new species, *J. [illegible]*, from [illegible] spotted Genet.

Of these, *J. chyzeri*, *J. [illegible]*, *J. [illegible]*, *J. pasqualei*, *J. echinorhynchoides*, *J. [illegible]* and *J. gervaisi* are recorded in dogs and cats. *J. [illegible]* and *J. echinorhynchoides* have, however, been recognised as the [illegible] valid species and the others that had been named are considered as their synonyms.

Indian reports on the occurrence of *Joyeuxiella*, as compiled and recorded[1-?] relate to *J. gervaisi*, *J. [illegible]* and *J. pasqualei*.

Coprophagous insects are referred to act as first intermediate host. Species of the reptilian genera *Lacerta*, *Hemidactylus*, *Tarentola*, *Natrix*, *Coluber*, *Psammodromus*, *Zamenis*, *Ablepharus*, *Varanus*, *Acanthodactylus*, *Chalcides*, *Eumeces*, *Stellio*, *Scincus*, *Phyllodactylus*, *Psammophis*, *Chamaeleo*, *Seps* and *Mabuya* and the mammalian genus *Crocidura* have been referred to[?] and recorded[?] as the second intermediate hosts for *J. pasqualei* and *J. [illegible]* [illegible] in dogs and cats, experimental development of the adults of *J. echinorhynchoides* has been mentioned[11-13] and of *J. pasqualei* recorded in cats.

During examination of 41 specimens of *Uromastix hardwickii* (procured from Agra), liver [illegible] abdominal muscles in two and the [illegible] in one yielded cysticercoid. The larval form on study, was tentatively identified as belonging to *Joyeuxiella*. Subsequent confirmation was accomplished by feeding experiments undertaken with two clean laboratory reared pups and a clean laboratory reared rabbit. Adult cestodes, recovered from the former alone, were found to represent *J. echinorhynchoides*. The cysticercoids and the adults are briefly described and the successful development of the latter recorded.

In the affected regions the cysticercoid occurred as white, millet sized, opaque spots which, after extraction and on mounting on slides, measured 0·344-1·407 mm × 1·087-1·40? mm in size. In these preparations, internal structures were not visible. With the pressure of a needle on the coverslip, the everted metacestodes, of elongated form and 1·724-2·391 mm in length and 0·623-0·957 mm in maximum width, revealed the characteristic suckers and the armed rostellum. The scolex, though not distinctly demarcated from the rest of the body, measured 0·435-0·753 mm in maximum width with the rounded suckers of 0·130-0·174 mm in diameter, and the evertible 0·174-0·333 mm × 0·101-0·130 mm sized rostellum carried 20-22 rows of typical hooks of rose thorn shape which gradually diminished in size in the posterior rows. In the anterior rows, the hooks had 21-28 μ long spine and the basal disc of 11-14 μ diameter. In the last row, the length of the spine was 9-14 μ with the basal disc of 7-11 μ diameter.

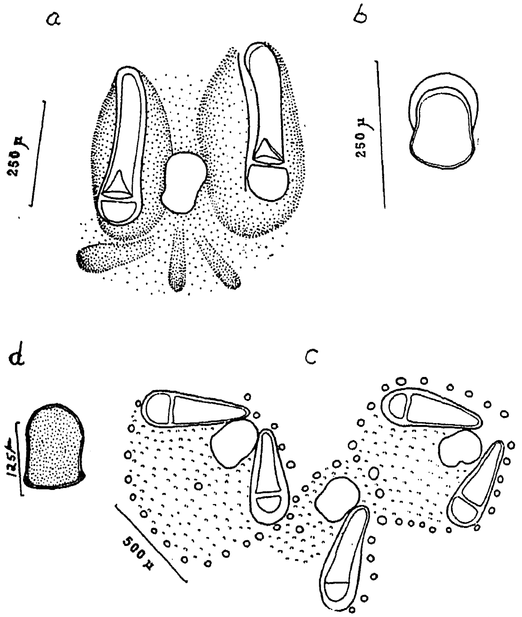
Eight cysticercoids were fed to one experimental pup while pieces of the affected livers were administered to the other pup and the rabbit. The first pup, on autopsy conducted on the 14th day of the infection, yielded four maturing specimens including a complete worm. The second pup, that died on 25th day of the infection, yielded 52 worms which were mostly adults. The rabbit, autopsied on 46th day, was free from infection.

The 14 day old complete specimen of 42 mm length had the scolex of 0·783 mm in maximum width with the suckers of 0·174 mm diameter and the rostellum, of 0·246 mm in length and 0·130 mm in diameter, carrying 20

epizoic on corals collected from the Gulf of Mannar and *T. ventricosa* Canu and Bassler epizoic on gastropod shells dredged from the Arabian Sea.

Members of this genus are characterised by an olscyst surmounted by a rugose, pleurocyst, centrally placed reniform pores, each zooecium separated by inter-junctural pores, three to five hollow peristomial spines and hyperstomial ovicells closed by the chitinised operculum.

1. *Tremogasterina granulata* CANU AND BASSLER, 1928 (FIG. 1, *a*-b)



FIGS. 1, *a*-*b*. Fig. *a*. *Tremogasterina granulata* Canu Bassler Single zooecium; Fig. *b*. Operculum; Fig. *c*. *T. ventricosa* Canu and Bassler Two zooecia; Fig. *d*. Operculum.

Salient features.—Encrusting. Distinct, elongate, elevate zooecia separated by small pores, which may be inconspicuous. Highly calcified and granulated front with a pore in the middle (Fig. 1, *a*). Elongate and sub-orbicular orifice with a concave border. Two cardelles present. Operculum chitinous with a continuous sclerite (Fig. 1, *b*). Large avicularia, placed on calcareous thickenings on either side of the orifice, directed distally. Mandibles long with slightly pointed ends. Three small oral spines present in juvenile zooecia. Length 500 µ and breadth 540 µ.

Remarks.—Calcification owing to age will give the colonies very complicated appearance and the front will be provided with ridges and grooves.

2. *Tremogasterina ventricosa* CANU AND BASSLER, 1928 (FIG. 1, *c*-*d*)

Salient features.—Zoarium encrusting. Young zooecia distinct, separated by interjunctural pores, which get obscured as a result of calcification. Convex front tuberculated with small reniform pores (Fig. 1, *c*). Aperture elongate oval. Thin peristome with three spines. Avicularia large with rounded tips. Mandible with a sub-marginal sclerite (Fig. 1, *d*). Ovicells not noticed. Length 500 µ and breadth 420 µ.

Remarks.—Only a few zooecia in the present instance have mucros, which are inconspicuous. Discussing, the range of variation in this species Canu and Bassler[2] state that the mucro is inconsistent and may often be wanting. The number of frontal pores vary from one zooecium to another, the beak of the avicularium may be pointed or rounded.

3. *Tremogasterina lanceolata* CANU AND BASSLE, 1928 (FIG. 2, *e*-*h*)

Salient features.—Zoarium encrusting, multilaminar. Distinct zooecia separated by a line of interjunctural pores (Fig. 2, *e*). Convex front provided with very small granulations. A median pore present. Cardelles small. Large anter and rather small poster. Chitinised, elongated oval operculum with a thin marginal sclerite. Avicularia large, often paired, usually pointed distally or rarely disto-medianly. Immersed ovicells tuberculated, often with a few large tubercles (Fig. 2, *g*). Ovicells closed by the operculum. Length 750 µ and breadth 625 µ.

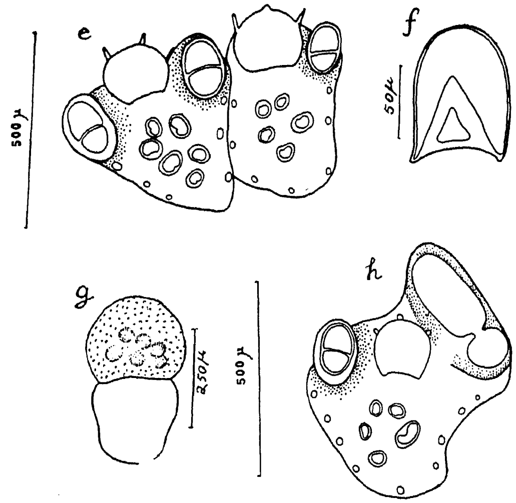


FIG. 2. *e*-*h*. *Tremogasterina lanceolata*. Fig. *e*, Two zooecia; Fig. *f*. Avicularian mandible; Fig. *g*. Ovicell. Adventitious avicularia,

[illegible]

1. [illegible] 1941, 21, 770.
2. [illegible] 1929, 72, [illegible]

A DILEPIDID CYSTICERCOID FROM *UROMASTIX HARDWICKII* AND ITS EXPERIMENTAL DEVELOPMENT IN PUP

[illegible] *J.* [illegible] Yamaguti has enlisted [illegible] species. Recognizing the species [illegible] by Yamaguti, Mettrick and Beverley-Burton [illegible] described a new species [illegible] Genet.

[illegible] *J.* [illegible] *J. pasqualei*, [illegible] and *J.* [illegible] dogs and cats. *J.* [illegible] have, however, been recognized as the [illegible] species [illegible] considered as [illegible].

Indian reports on the occurrence of *Joyeuxiella*, as compiled [illegible] and recorded[illegible] relate to *J.* [illegible] and *J. pasqualei*.

Coprophagous insects [illegible] to act as first intermediate host. Species of the reptilian genera [illegible] Hemidactylus, *Tarentola*, *Mabuya*, [illegible], *Varanus*, *Acanthodactylus*, *Chalcides*, [illegible] *Ptyodactylus*, [illegible] *Seps* and *Mabuia* and the mammalian genus *Crocidura* have been reported[illegible] and recorded[illegible] as the second intermediate host for *J. pasqualei*

and *J.* [illegible] its dogs and cats, [illegible] experimental development of the adults of *J.* [illegible] been mentioned [illegible] natural host[illegible].

During [illegible] of 41 specimen of *Uromastix hardwickii* [illegible] collected from Ajmer, [illegible] two and [illegible] cysticercoid. [illegible] tentatively [illegible] belonging to *Joyeuxiella*. [illegible] accomplished [illegible] with two clean [illegible] and [illegible] laboratory [illegible] recovered from [illegible] found to represent *J.* [illegible]. The cysticercoids and [illegible] described and the [illegible] recorded.

In the [illegible] the cysticercoid [illegible] whitish [illegible] opaque spots [illegible] on mounting on [illegible] measured 0.844–1.465 mm × 1.087–1.40[illegible]. In these preparations, internal structures were not visible. With the pressure of a needle on the coverslip, the [illegible] of elongated form and 1.224–2.394 mm in length and 0.623–0.957 mm in maximum width, revealed the characteristic suckers and the armed rostellum. The scolex, though not distinctly demarcated from the rest of the body, measured 0.435–0.753 mm in maximum width with the rounded suckers of 0.130–0.174 mm in diameter and the evertible 0.174–0.333 mm × 0.101–0.130 mm [illegible] rostellum carried 20–22 rows of typical hooks of rose thorn shape which gradually diminished in size in the posterior rows. In the anterior rows the hooks had 21.28 µ long spine and the basal disc of 11.14 µ diameter. In the last row the length of the spine was 9.14 µ with the basal disc of 7.11 µ diameter.

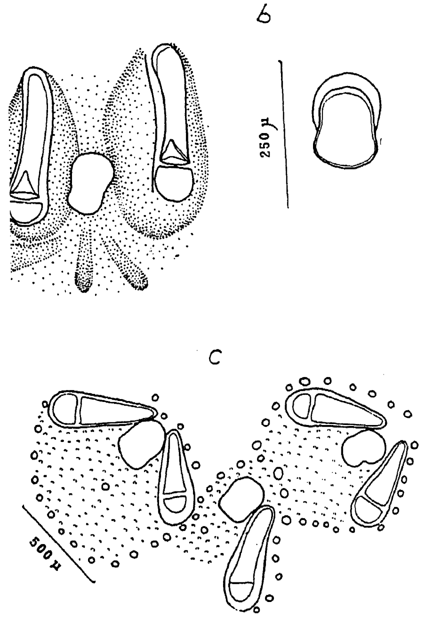
Eight cysticercoids were fed to one experimental pup while pieces of the affected livers were administered to the other pup and the rabbit. The first pup, on autopsy conducted on the 14th day of the infection, yielded four immature specimens including a complete worm. The second pup that died on 25th day of the infection yielded 37 worms which were mostly adults. The rabbit, autopsied on 40th day, was free from infection.

The 14 day old complete specimen of 42 mm length had the scolex of 0.783 mm in maximum width with the suckers of 0.174 mm diameter and the rostellum of 0.246 mm in length and 0.130 mm in diameter, carrying 20

: corals collected from the Gulf of
nd *T. ventricosa* Canu and Bassler
gastropod shells dredged from the
ea.

s of this genus are characterised by
surmounted by a rugose, pleurocyst,
›laced reniform pores, each zooecium
by inter-junctural pores, three to
r peristomial spines and hyperstomial
›sed by the chitinised operculum.

mogasterina granulata Canu and
Bassler, 1928 (Fig. 1, *a*–*b*)



-*b*. **Fig. *a*.** ***Tremogasterina granulata*** **Canu**
: zooecium; Fig. *b*. Operculum; Fig. *c*.
Canu and Bassler Two zooecia; Fig. *d*.

features.—Encrusting. Distinct,
levate zooecia separated by small
:h may be inconspicuous. Highly
d granulated front with a pore in
: (Fig. 1, *a*). Elongate and sub-
:ifice with a concave border. Two
resent. Operculum chitinous with
; sclerite (Fig. 1, *b*). Large avicularia,
alcareous thickenings on either side
ice, directed distally. Mandibles
lightly pointed ends. Three small
present in juvenile zooecia. Length
readth 540 μ.

–Calcification owing to age will
onies very complicated appearance
ıt will be provided with ridges and

2. *Tremogasterina ventricosa* Canu and Bassler, 1928 (Fig. 1, *c*–*d*)

Salient features.—Zoarium encrusting. Young zooecia distinct, separated by interjunctural pores, which get obscured as a result of calcification. Convex front tuberculated with small reniform pores (Fig. 1, *c*). Aperture elongate oval. Thin peristome with three spines. Avicularia large with rounded tips. Mandible with a sub-marginal sclerite (Fig. 1, *d*). Ovicells not noticed. Length 500 μ and breadth 420 μ.

Remarks.—Only a few zooecia in the present instance have mucros, which are inconspicuous. Discussing, the range of variation in this species Canu and Bassler[2] state that the mucro is inconsistent and may often be wanting. The number of frontal pores vary from one zooecium to another, the beak of the avicularium may be pointed or rounded.

3. *Tremogasterina lanceolata* Canu and Bassle, 1928 (Fig. 2, *e*–*h*)

Salient features.—Zoarium encrusting, multilaminar. Distinct zooecia separated by a line of interjunctural pores (Fig. 2, *e*). Convex front provided with very small granulations. A median pore present. Cardelles small. Large anter and rather small poster. Chitinised, elongated oval operculum with a thin marginal sclerite. Avicularia large, often paired, usually pointed distally or rarely disto-medianly. Immersed ovicells tuberculated, often with a few large tubercles (Fig. 2, *g*). Ovicells closed by the operculum. Length 750 μ and breadth 625 μ.

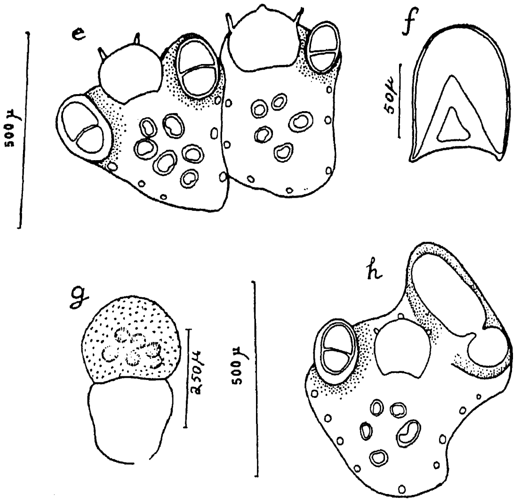


Fig. 2. *e*–*h*. *Tremogasterina lanceolata*. **Fig. *e*, Two zooecia; Fig. *f*. Avicularian mandible; Fig. *g*. Ovicell. Adventitious avicularia,**

Remarks.—
area makes
difficult. T
resemblance
studied by
from nearly
the present s

Indian Ocear
Biological
National Inst
Oceanogra
Cochin-18 (
and
The Marinc
Biological
University o:
Trivandrum-

---

1. Canu, F.
2. — and B
72, 14,

A DILEP
UROMAS
EXPER

Under *Joyeu*
Lopez-Neyra
lidea), pa
J. chyzeri
species have
excluded or
species incl
Beverley-Bu
species, *J.*
Genet.

of the
J. pasquale
and *J. gerv*
J. pasquale
however, b
species and
considered

Indian
Joyeuxiella,
relate to *J.*

Copropha
as first
the reptilia
Terentola,
Zamenis, *A*
Chalcidus,
tylus, *Psa*
Mabuya an
have been
the second

Remarks.—The calcification of the frontal area makes a detailed study of the species difficult. This form shows some general resemblance to *T. granulata*. The specimens studied by Canu and Bassler were collected from nearly 240 and 261 metres depth, while the present specimens are taken from 10 metres.

Indian Ocean N. RAVINDRANATHA MENON.
Biological Centre,
National Institute of
Oceanography,
Cochin-18 (India),
and
The Marine N. BALAKRISHNAN NAIR.
Biological Lab.,
University of Kerala,
Trivandrum-7 (India), *October* 27, 1969.

---

1. Canu, F. *An. Mus. nac. B. Aires*, 1911, **21**, 256.
2. — and Bassler, R. S., *Proc. U.S. nat. Mus.*, 1928, **72**, 14, 45.

A DILEPIDID CYSTICERCOID FROM *UROMASTIX HARDWICKII* AND ITS EXPERIMENTAL DEVELOPMENT IN PUP

UNDER *Joyeuxiella* Führmann, 1935 (= *Joyeuxia* Lopez-Neyra, 1927) (Dilepididæ: Cyclophyllidea), parasitising carnivorous mammals, *J. chyzeri* (its genotype) and nine other species have been listed[11] while Yamaguti[13] has excluded one species, *J.* sp. Recognising the species included by Yamaguti, Mettrick and Beverley-Burton[5] have described a new species, *J. paucitestis*, from Rusty Spotted Genet.

of these, *J. chyzeri*, *J. führmanni*, *J. pasqualei*, *J. pasqualeiformis*, *J. rossicum* and *J. gervaisi* are recorded in dogs and cats. *J. pasqualei* and *J. echinorhynchoides* have, however, been recognised as the two valid species and the others that had been named are considered as their synonyms.[4,8,12]

Indian reports on the occurrence of *Joyeuxiella*, as compiled[10] and recorded,[1,3,7,9] relate to *J. gervaisi*, *J. chyzeri* and *J. pasqualei*.

Coprophagous insect is believed to act as first intermediate host.[12] Species of the reptilian genera: *Lacerta*, *Hemidactylus*, *Terentola*, *Natrix*, *Coluber*, *Tropidonotus*, *Zamenis*, *Ailurophis*, *Varanus*, *Acanthodactylus*, *Chalcidus*, *Trapelus*, *Stellio*, *Scincus*, *Ptyodactylus*, *Psammophis*, *Cœlopeltis*, *Seps* and *Mabuya* and the mammalian genus *Crocidura* have been referred to[11,13] and recorded[2,6] as the second intermediate hosts for *J. pasqualei* and *J. echniorhynchoides*. In dogs and cats, experimental development of the adults of *J. echinorhynchoides* has been mentioned[11,13] and of *J. pasqualei* recorded in cat.[6]

During examination of 41 specimens of *Uromastix hardwickii* (procured from Agra), liver from four, abdominal muscles in two and the mesentery in one yielded cysticercoids. This larval form, on study, was tentatively identified as belonging to *Joyeuxiella*. Subsequent confirmation was accomplished by feeding experiments undertaken with two clean laboratory-reared pups and a clean laboratory-bred rabbit. Adult cestodes, recovered from the former alone, were found to represent *J. echinorhynchoides*. The cysticercoids and the adults are briefly described and the successful development of the latter recorded.

In the attacked regions, the cysticercoids occurred as white, millet-sized, opapue spots which, after extraction and on mounting on slides, measured 0·844–1·407 mm. × 1·087–1·407 mm. in size. In these preparations, internal structures were not visible. With the pressure of a needle on the coverslip, the excysted juveniles, of elongated form and 1·724–2·391 mm. in length and 0·623–0·957 mm. in maximum width, revealed the characteristic suckers and the armed rostellum. The scolex, though not distinctly demarcated from the rest of the body, measured 0·435–0·753 mm. in maximum width with the rounded suckers of 0·130–0·174 mm. in diameter, and the eversible 0·174–0·333 mm. × 0·101–0·130 mm. sized rostellum carried 20–22 rows of typical hooks of rose-thorn shape which gradually diminished in size in the posterior rows. In the anterior rows, the hooks had 21–28 μ long spine and the basal disc of 11–14 μ diameter. In the last row, the length of the spine was 9–14 μ with the basal disc of 7–11 μ diameter.

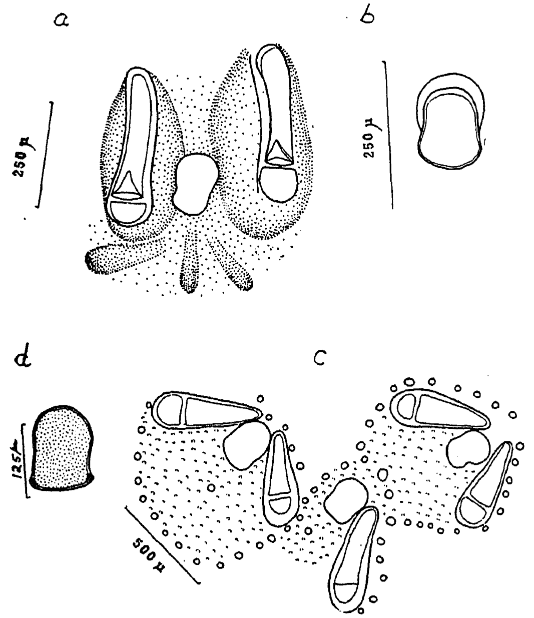
Eight cysticercoids were fed to one experimental pup while pieces of the affected livers were administered to the other pup and the rabbit. The first pup, on autopsy conducted on the 14th day of the infection, yielded four maturing specimens including a complete worm. The second pup, that died on 25th day of the infection, yielded 52 worms which were mostly adults. The rabbit, autopsied on 46th day, was free from infection.

The 14-day old complete specimen of 42 mm. length had the scolex of 0·783 mm. in maximum width with the suckers of 0·174 mm. diameter and the rostellum, of 0·246 mm. in length and 0·130 mm. in diameter, carrying 20

epizoic on corals collected from the Gulf of Mannar and *T. ventricosa* Canu and Bassler epizoic on gastropod shells dredged from the Arabian Sea.

Members of this genus are characterised by an olscyst surmounted by a rugose, pleurocyst, centrally placed reniform pores, each zooecium separated by inter-junctural pores, three to five hollow peristomial spines and hyperstomial ovicells closed by the chitinised operculum.

1. *Tremogasterina granulata* Canu and Bassler, 1928 (Fig. 1, *a–b*)



FIGS. 1, *a–b*. Fig. *a*. *Tremogasterina granulata* Canu Bassler Single zooecium; Fig. *b*. Operculum; Fig. *c*. *T. ventricosa* Canu and Bassler Two zooecia; Fig. *d*. Operculum.

Salient features.—Encrusting. Distinct, elongate, elevate zooecia separated by small pores, which may be inconspicuous. Highly calcified and granulated front with a pore in the middle (Fig. 1, *a*). Elongate and sub-orbicular orifice with a concave border. Two cardelles present. Operculum chitinous with a continuous sclerite (Fig. 1, *b*). Large avicularia, placed on calcareous thickenings on either side of the orifice, directed distally. Mandibles long with slightly pointed ends. Three small oral spines present in juvenile zooecia. Length 500 µ and breadth 540 µ.

Remarks.—Calcification owing to age will give the colonies very complicated appearance and the front will be provided with ridges and grooves.

2. *Tremogasterina ventricosa* Canu and Bassler, 1928 (Fig. 1, *c–d*)

Salient features.—Zoarium encrusting. Young zooecia distinct, separated by interjunctural pores, which get obscured as a result of calcification. Convex front tuberculated with small reniform pores (Fig. 1, *c*). Aperture elongate oval. Thin peristome with three spines. Avicularia large with rounded tips. Mandible with a sub-marginal sclerite (Fig. 1, *d*). Ovicells not noticed. Length 500 µ and breadth 420 µ.

Remarks.—Only a few zooecia in the present instance have mucros, which are inconspicuous. Discussing, the range of variation in this species Canu and Bassler[2] state that the mucro is inconsistent and may often be wanting. The number of frontal pores vary from one zooecium to another, the beak of the avicularium may be pointed or rounded.

3. *Tremogasterina lanceolata* Canu and Bassle, 1928 (Fig. 2, *e–h*)

Salient features.—Zoarium encrusting, multilaminar. Distinct zooecia separated by a line of interjunctural pores (Fig. 2, *e*). Convex front provided with very small granulations. A median pore present. Cardelles small. Large anter and rather small poster. Chitinised, elongated oval operculum with a thin marginal sclerite. Avicularia large, often paired, usually pointed distally or rarely disto-medianly. Immersed ovicells tuberculated, often with a few large tubercles (Fig. 2, *g*). Ovicells closed by the operculum. Length 750 µ and breadth 625 µ.

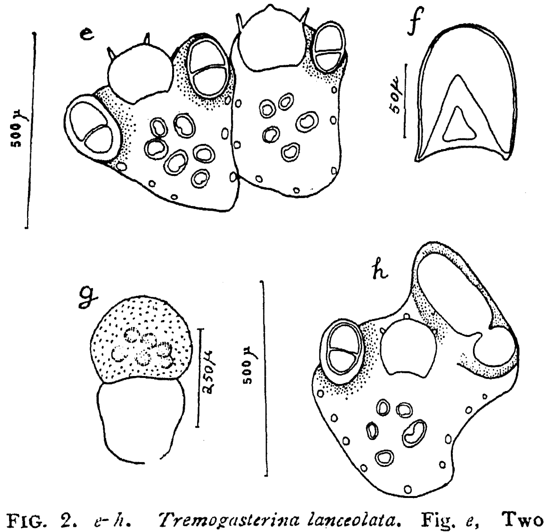


FIG. 2. *e–h*. *Tremogasterina lanceolata*. Fig. *e*, Two zooecia; Fig. *f*. Avicularian mandible; Fig. *g*. Ovicell. Adventitious avicularia.

Remarks.—The calcification of the frontal area makes a detailed study of the species difficult. This form shows some general resemblance to *T. granulata.* The specimens studied by Canu and Bassler were collected from nearly 240 and 261 metres depth, while the present specimens are taken from 10 metres.

Indian Ocean N. RAVINDRANATHA MENON.
Biological Centre,
National Institute of
Oceanography,
Cochin-18 (India),
and
The Marine N. BALAKRISHNAN NAIR.
Biological Lab.,
University of Kerala,
Trivandrum-7 (India), *October* 27, 1969.

---

1. Canu, F. *An. Mus. nac. B. Aires*, 1911, **21**, 256.
2. — and Bassler, R. S., *Proc. U.S. nat. Mus.*, 1928, **72**, 14, 45.

A DILEPIDID CYSTICERCOID FROM *UROMASTIX HARDWICKII* AND ITS EXPERIMENTAL DEVELOPMENT IN PUP

UNDER *Joyeuxiella* Führmann, 1935 (= *Joyeuxia* Lopez-Neyra, 1927) (Dilepididæ: Cyclophyllidea), parasitising carnivorous mammals, *J. chyzeri* (its genotype) and nine other species have been listed[11] while Yamaguti[13] has excluded one species, *J.* sp. Recognising the species included by Yamaguti, Mettrick and Beverley-Burton[5] have described a new species, *J. paucitestis*, from Rusty Spotted Genet.

of these, *J. chyzeri, J. führmanni, J. pasqualei, J. pasqualeiformis, J. rossicum* and *J. gervaisi* are recorded in dogs and cats. *J. pasqualei* and *J. echinorhynchoides* have, however, been recognised as the two valid species and the others that had been named are considered as their synonyms.[1,8,12]

Indian reports on the occurrence of *Joyeuxiella,* as compiled[10] and recorded,[1,3,7,9] relate to *J. gervaisi, J. chyzeri* and *J. pasqualei.*

Coprophagous insect is believed to act as first intermediate host.[12] Species of the reptilian genera: *Lacerta, Hemidactylus, Terentola, Natrix, Coluber, Tropidonotus, Zamenis, Ailurophis, Varanus, Acanthodactylus, Chalcidus, Trapelus, Stellio, Scincus, Ptyodactylus, Psammophis, Cœlopeltis, Seps* and *Mabuya* and the mammalian genus *Crocidura* have been referred to[11,13] and recorded[2,6] as the second intermediate hosts for *J. pasqualei* and *J. echniorhynchoides.* In dogs and cats, experimental development of the adults of *J. echinorhynchoides* has been mentioned[11,13] and of *J. pasqualei* recorded in cat.[6]

During examination of 41 specimens of *Uromastix hardwickii* (procured from Agra), liver from four, abdominal muscles in two and the mesentery in one yielded cysticercoids. This larval form, on study, was tentatively identified as belonging to *Joyeuxiella.* Subsequent confirmation was accomplished by feeding experiments undertaken with two clean laboratory-reared pups and a clean laboratory-bred rabbit. Adult cestodes, recovered from the former alone, were found to represent *J. echinorhynchoides.* The cysticercoids and the adults are briefly described and the successful development of the latter recorded.

In the attacked regions, the cysticercoids occurred as white, millet-sized, opapue spots which, after extraction and on mounting on slides, measured 0·844–1·407 mm. × 1·087–1·407 mm. in size. In these preparations, internal structures were not visible. With the pressure of a needle on the coverslip, the excysted juveniles, of elongated form and 1·724–2·391 mm. in length and 0·623–0·957 mm. in maximum width, revealed the characteristic suckers and the armed rostellum. The scolex, though not distinctly demarcated from the rest of the body, measured 0·435–0·753 mm. in maximum width with the rounded suckers of 0·130–0·174 mm. in diameter, and the eversible 0·174–0·333 mm. × 0·101–0·130 mm. sized rostellum carried 20–22 rows of typical hooks of rose-thorn shape which gradually diminished in size in the posterior rows. In the anterior rows, the hooks had 21–28 μ long spine and the basal disc of 11–14 μ diameter. In the last row, the length of the spine was 9–14 μ with the basal disc of 7–11 μ diameter.

Eight cysticercoids were fed to one experimental pup while pieces of the affected livers were administered to the other pup and the rabbit. The first pup, on autopsy conducted on the 14th day of the infection, yielded four maturing specimens including a complete worm. The second pup, that died on 25th day of the infection, yielded 52 worms which were mostly adults. The rabbit, autopsied on 46th day, was free from infection.

The 14-day old complete specimen of 42 mm. length had the scolex of 0·783 mm. in maximum width with the suckers of 0·174 mm. diameter and the rostellum, of 0·246 mm. in length and 0·130 mm. in diameter, carrying 20 crowns of hooks with spines ranging from 28 to 29 μ in the anterior rows to 12–14 μ in posterior row and the 66 segments included some which were mature. No gravid segments had, however, developed.

The 25-day old specimens, of 57–200 mm. length, had the scolex of 0·406–0·623 mm. in maximum width; the rostellum, 0·203–0·507 mm. long and 0·115–0·188 mm. in maximum width at its base, with 20–22 rows of hooks having spines longer than the basal discs—the anterior rows with spine of 23–28 μ in length and basal disc of 11–14 μ diameter while the posterior row contained 11–14 μ long spine and the basal disc of 5–9 μ in diameter; the suckers of 0·144–0·188 mm. in diameter; the typical mature segment longer than broad and of 2·028–2·884 mm. × 1·233–1·464 mm. size; the genital pore situated at 0·681–0·942 mm. distance behind the anterior margin; the 70–110 testes of 0·086–0·115 mm. × 0·057–0·087 mm. size; the cirrus sac of 0·159–0·391 mm. × 0·086–0·130 mm. in size, crossing the longitudinal excretory canal and with a coiled seminal vesicle and an unspined cirrus; the gravid segment, also longer than broad, had 91–109 μ × 75–95 μ sized egg capsules distributed between the longitudinal excretory vessels—each capsule having an egg of 51–85 μ × 48–75 μ size.

On account of the total body size, the character of the scolex and the rostellar hooks with the disc smaller than the spine, and in the distribution of the egg capsules, our specimens exhibited features specific for *J. echinorhynchoides*. Slight variation in the total size of rostellar hooks, testes, egg capsules and the contained eggs were, however, observed. The specimens have been determined as belonging to *J. echinorhynchoides* of which the cysticercoid is recorded, for the first time, from *Uromastix hardwickii*, evidently a natural second intermediary in this region. The development to the adult form, with the prepatent period of 25 days, has also been reported in experimental pups.

Grateful acknowledgement is due to Dr. B. P. Pande, Professor of Parasitology, for supervision and going through the manuscript and to the Indian Council of Agricultural Research for the award of Senior Research Fellowship in Helminthology.

Department of Parasitology, V. P. Gupta.
U.P. College of Veterinary
Science and Animal Husbandry,
Mathura (U.P.), *June* 10, 1969.

---

1. Bhatia, B. B., Sood, S. M. and Pande, B. P., *Indian vet. J.*, 1959 **35**, 598
2. Fitzsimmons, W. M., *Vet. Med.*, 1961, **56**, 68.
3. Gupta, V. P., *Agra Univ. J. Res. (Sci.)*, 1963, **12**, 63.
4. Hughes, R. C., Baker, J. H. and Dawson, G. B., *Am. Midl. Nat.*, 1941, **25**, 454.
5. Mettrick, D. F. and Beverly-Burton, M., *Parasitol.*, 1961, **51**, 533.
6. Mimioglu, M. and Sayin, F., *Vet. Fak. Derg. Ankara Univ.* (Turkish summary p. 109), 1963, **10**, 103.
7. Mudaliar, S. V. and Alwar, V. S., *Indian vet. J.*, 1947, **23**, 423.
8. Neveu Lemaire, M., *Traité d'helminthologie médicale et vétérinaire* Paris, 1936, p. 1514.
9. Rao, M. A. N., *Indian J. vet. Sci.*, 1939, **10**, **377**.
10. Southwell, T., *The Fauna of British India Including Ceylon and Burma.*—Vol. I, *Cestoda*, Taylor and Francis, London, 1930, p. 391.
11. Wardle, R. A. and Mc Leod, J. A., *The Zoology of Tapeworms.* University of Minnesota Press, Minneapolis, 1952, p. 780.
12. Witenberg, G., *Z. Prasitenk.*, 1932, **4**, 542.
13. Yamaguti, S., *Systema Helminthum*—Vol. II: *The Cestodes of Vetebrates*, Interscience Publishers, New York, London, 1959, p. 860.

EFFECT OF PHOTO-INDUCTION ON THE CRITICAL PHOTOPERIOD OF *CHENOPODIUM ALBUM* L.

Extreme sensitivity of genus *Chenopodium*[1] to daylength has attracted much attention. Indeed wide variation in photoperiodic responses[2] between different species is reported. In *C. album* floral initiation occurs rapidly and photoperiodic responses are not very clear. Some report it to be an intermediate[3] plant while others include it under short-day[4] plants. Earlier investigations revealed that plants grown under 20-hour photoperiod failed to flower.[5] The present note describes the results of investigations on critical photoperiod of *C. album* and also the extent to which the requirement for daylength for flowering is altered by previous induction to periods longer and shorter than the critical.

Plants were raised upto 4-leaf stage at 10-hour photoperiod, from seeds collected from a wheat field, Banaras Hindu University, during March-April, 1965. The experiment was conducted between January 9 and February 8, 1968. At the start of the experiment, number of seedlings were thinned to three per pot. The pots were arranged in 15 series of three pots each. The experimental photoperiodic schedule is given below:

Series 1-5 were exposed to photoperiods varying between 13½-15½ hour with a rise of ½ hour for each consecutive series, for 10 days.

[illegible]

TABLE I

[illegible]

[illegible]	[illegible]	[illegible]
1	[illegible]	3·0
2	[illegible]	45·0
3	[illegible]	[illegible]
4	[illegible]	3·0
5	[illegible]	[illegible]
6	[illegible]	0·0
7	[illegible]	1·0
8	[illegible]	[illegible]
9	[illegible]	13·0
10	[illegible]	[illegible]
11	[illegible]	1·0
12	[illegible]	1·0
13	[illegible]	3·0
14	[illegible]	[illegible]
15	[illegible]	[illegible]

[illegible] series 1 [illegible] reveal that [illegible] critical daylength has [illegible] treatment of 14 hours [illegible] 14 hour photoperiod and [illegible] increase in flower number in series 9 and [illegible] 13 and 15 [illegible] data [illegible] are given clearly indicates that the critical photoperiod has shifted. Since the uniform treatment exhibited that flowering becomes negligible at daylength greater than 14 hours (series 4). There is a gradual increase in number of flowers with the reduction in photoperiod from series 11 and 15. It proves that flowering can be induced in C. album growing at longer daylengths (more than critical) by transferring the plants after 5 days to short-day conditions. This is again a shift in the [illegible] photoperiod of the plant. Schwabe[3] re[illegible] short-day plant *Kalanchoe* [illegible] treatment [illegible] daylength exceeding the critical [illegible] than follows [illegible] He tried to explain the photo[illegible] of an inhibitor formed [illegible] adaptively form[illegible] critical [illegible] period.

From the present study, it is anticipated that [illegible] of an adaptive enzyme in the plant [illegible] control of flowering [illegible] the formation of a [illegible] flowering substance. Flowering [illegible] to the concentration of [illegible]. The development and the quantity of the enzyme depend upon the daylength. In short-day plant flower below [illegible] critical [illegible] plants [illegible] critical level of the enzyme. In C. album the [illegible] concentration of the enzyme [illegible] at 13 hours and with increasing daylength concentration of the enzyme becomes [illegible] which has a retarding influence on flowering. Plants maintained at longer daylength [illegible] quantity of the enzyme [illegible] transferring them to decreasing photo[illegible] further secretion of the enzyme [illegible]. Flowering in such plant [illegible] daylength suitable to the con[illegible] of the enzyme [illegible]. However [illegible] may be held but evidence [illegible] that processes involved in induction [illegible] and only the pro[illegible] and rate of enzyme formation differ under different daylength. The critical daylength would then be that value at which the [illegible] of the adaptive enzyme [illegible] to inhibit the flowering process. This explains the flowering at photoperiods [illegible] than critical.

The author is grateful to Prof. R. Misra and Dr. K. C. Misra for helpful suggestions and going through the manuscript. The research has been financed in part by the PL 480 grant of U.S.D.A.

Dept. of Botany, S. R. GUPTA
Banaras Hindu University,
Varanasi 5, October 21, 1969.

1. [illegible], *Nature* 1959 **184**, 1044.
2. —, [illegible] 1967 **45**, 2173.
3. Schwabe, W. W. [illegible] *Photoperiodism*, 1957 p. 95.
4. —, [illegible], Toronto Press, 1961.
5. Gupta, S. R., [illegible], Banaras Hindu University, 1968, p. 120.

crowns of hooks with spines ranging from 28 to 29 μ in the anterior rows to 12–14 μ in posterior row and the 66 segments included some which were mature. No gravid segments had, however, developed.

The 25-day old specimens, of 57–200 mm. length, had the scolex of 0·406–0·623 mm. in maximum width; the rostellum, 0·203–0·507 mm. long and 0·115–0·188 mm. in maximum width at its base, with 20–22 rows of hooks having spines longer than the basal discs—the anterior rows with spine of 23–28 μ in length and basal disc of 11–14 μ diameter while the posterior row contained 11–14 μ long spine and the basal disc of 5–9 μ in diameter; the suckers of 0·144–0·188 mm. in diameter; the typical mature segment longer than broad and of 2·028–2·884 mm. × 1·233–1·464 mm. size; the genital pore situated at 0·681–0·942 mm. distance behind the anterior margin; the 70–110 testes of 0·086–0·115 mm. × 0·057–0·087 mm. size; the cirrus sac of 0·159–0·391 mm. × 0·086–0·130 mm. in size, crossing the longitudinal excretory canal and with a coiled seminal vesicle and an unspined cirrus; the gravid segment, also longer than broad, had 91–109 μ × 75–95 μ sized egg capsules distributed between the longitudinal excretory vessels—each capsule having an egg of 51–85 μ × 48–75 μ size.

On account of the total body size, the character of the scolex and the rostellar hooks with the disc smaller than the spine, and in the distribution of the egg capsules, our specimens exhibited features specific for *J. echinorhynchoides*. Slight variation in the total size of rostellar hooks, testes, egg capsules and the contained eggs were, however, observed. The specimens have been determined as belonging to *J. echinorhynchoides* of which the cysticercoid is recorded, for the first time, from *Uromastix hardwickii*, evidently a natural second intermediary in this region. The development to the adult form, with the prepatent period of 25 days, has also been reported in experimental pups.

Grateful acknowledgement is due to Dr. B. P. Pande, Professor of Parasitology, for supervision and going through the manuscript and to the Indian Council of Agricultural Research for the award of Senior Research Fellowship in Helminthology.

Department of Parasitology, V. P. GUPTA.
U.P. College of Veterinary
Science and Animal Husbandry,
Mathura (U.P.), *June* 10, 1969.

---

1. Bhatia, B. B., Sood, S. M. and Pande, B. P., *Indian vet. J.*, 1959 **35**, 598
2. Fitzsimmons, W. M., *Vet. Med.*, 1961, **56**, 68.
3. Gupta, V. P., *Agra Univ. J. Res. (Sci.)*, 1963, **12**, 63.
4. Hughes, R. C., Baker, J. H. and Dawson, G. B., *Am. Midl. Nat.*, 1941, **25**, 454.
5. Mettrick, D. F. and Beverly-Burton, M., *Parasitol.*, 1961, **51**, 533.
6. Mimioglu, M. and Sayin, F., *Vet. Fak. Derg. Ankara Univ.* (Turkish summary p. 109), 1963, **10**, 103.
7. Mudaliar, S. V. and Alwar, V. S., *Indian vet. J.*, 1947, **23**, 423.
8. Neveu Lemaire, M., *Traité d'helminthologie médicale et vétérinaire* Paris, 1936, p. 1514.
9. Rao, M. A. N., *Indian J. vet. Sci.*, 1939, **10**, 377.
10. Southwell, T., *The Fauna of British India Including Ceylon and Burma.*—Vol. I, *Cestoda*, Taylor and Francis, London, 1930, p. 391.
11. Wardle, R. A. and Mc Leod, J. A., *The Zoology of Tapeworms.* University of Minnesota Press, Minneapolis, 1952, p. 780.
12. Witenberg, G., *Z. Prasitenk.*, 1932, **4**, 542.
13. Yamaguti, S., *Systema Helminthum*—Vol. II : *The Cestodes of Vetebrates*, Interscience Publishers, New York, London, 1959, p. 860.

EFFECT OF PHOTO-INDUCTION ON THE CRITICAL PHOTOPERIOD OF *CHENOPODIUM ALBUM* L.

EXTREME sensitivity of genus *Chenopodium*[1] to daylength has attracted much attention. Indeed wide variation in photoperiodic responses[2] between different species is reported. In *C. album* floral initiation occurs rapidly and photoperiodic responses are not very clear. Some report it to be an intermediate[3] plant while others include it under short-day[4] plants. Earlier investigations revealed that plants grown under 20-hour photoperiod failed to flower.[5] The present note describes the results of investigations on critical photoperiod of *C. album* and also the extent to which the requirement for daylength for flowering is altered by previous induction to periods longer and shorter than the critical.

Plants were raised upto 4-leaf stage at 10-hour photoperiod, from seeds collected from a wheat field, Banaras Hindu University, during March-April, 1965. The experiment was conducted between January 9 and February 8, 1968. At the start of the experiment, number of seedlings were thinned to three per pot. The pots were arranged in 15 series of three pots each. The experimental photoperiodic schedule is given below:

Series 1-5 were exposed to photoperiods varying between 13½-15½ hour with a rise of ½ hour for each consecutive series, for 10 days.

In series 6-10 during first five days photoperiod was increased from 13½ to 15½ with half-hour increase every day. Subsequently, the plants of series 6, 7, 8, 9 and 10 were exposed to 13½, 14, 14½, 15 and 15½ hour photoperiods, respectively for five days. For series 11 to 16 during the first five days the photoperiod was decreased from 15½ to 13½ hour with half-hour decrease for consecutive series per day and during the next five days plants of series 11, 12, 13, 14 and 15 were kept at 15½, 15, 14½, 14 and 13½ hour, respectively. After 10 days, treatment as described, the plants of all the series were kept at natural photoperiod of 10½ hour for 20 days before counting the number of flowers and flowering nodes.

The data are given in table I.

TABLE I

Effect of varying photoperiods on flowering of C. album

Series	Number of flowers	Percentage nodes flowering
1	172±16•4	83•0
2	86± 9•8	45•0
3	21± 4•4	10•0
4	4± 2•2	3•0
5	2± 1•2	0•5
6	0± 0•0	0•0
7	6± 0•0	4•0
8	15± 6•6	9•6
9	29± 2•8	13•0
10	39± 5•3	23•0
11	1± 0•0	1•0
12	2± 1•2	1•0
13	4± 2•6	3•0
14	9± 3•5	8•6
15	16± 3•5	10•0

It is observed from series 1 to 5 that the critical photoperiod for flowering of *C. album* is 14½ hours. Plants of series 6-10 reveal that cycles at or exceeding critical daylength have promotive effect. The number of flower is more than double by five-day treatment at 14½ hour (series 8) as compared to 14 hour photoperiod, and a further increase in flower number in series 9 and 10 where 15 and 15½ hour cycles are given clearly indicates that the critical photoperiod has shifted. [Since the uniform treatment exhibited that flowering becomes negligible at daylength greater than 14½ hour (series 4).] There is a gradual increase in number of flowers with the reduction in photoperiod from series 11 and 15. It proves that flowering can be induced in *C. album* growing at longer daylengths (more than critical) by transferring the plants after 5 days to short-day conditions. This is again a shift in the critical photoperiod of the plant. Schwabe[3] reported that in short-day plants (*Kalanchœ blossfediana* and *Perilla ecymoides*) treatment with daylengths exceeding the critical promotes flowering, when they follow some previous induction. He tried to explain the phenomenon on the basis of an inhibitor formed in long days which interacts with adaptively formed enzyme. This enzyme is assumed to increase in concentration during induction period.

From the present study, it is anticipated that production of an adaptive enzyme is the main environmental trigger in control of flowering and this enzyme catalyses the formation of a flower-promoting substance. Flowering is a quantitative response to the concentration of this enzyme. The development and the quantity of this enzyme depends upon the daylength. The short-day plants flower below a critical limit, while long-day plants above certain critical limit of the enzyme. In *C. album*, the optimum concentration of this enzyme is attained at 13½ hours and with increasing daylength concentration of the enzyme becomes supra-optimal which has a retarding influence on flowering. Plants maintained at longer daylengths develop higher quantity of this enzyme and on transferring them to decreasing photoperiods further secretion of the enzyme is presumably checked. Flowering in such plants initiates when daylength suitable to the concentration of this enzyme is supplied. However, no generalization may be held but evidences suggest that processes involved in induction proceed continuously and that only the proportion and rate of enzyme formation differs under different daylengths. The critical daylength would then be that value at which the proportion of the adaptive enzyme neither promotes nor inhibits the flowering process. This explains the flowering at photoperiods other than critical.

The author is grateful to Prof. R. Misra and Dr. K. C. Misra for helpful suggestions and going through the manuscript. The research has been financed in part by the PL 480 grants of U.S.D.A.

Dept. of Botany, S. R. GUPTA.
Banaras Hindu University,
Varanasi-5, October 21, 1969.

---

1. Cumming, B. C., *Nature*, 1959, **184, 1044.**
2. —, *Canad. J. Bot.*, 1967, **45,** 2173
3. Schwabe, W. W. *Publ. No. 34*, *Ser. Bde. I*, *UISB Pharma*. 1957 p 95.
4. —, *Recent Advances in Botany*, Toronto Press, 1961.
5. Gupta, S. R., *Pl 480 Ecology Rep.*, Banaras Hindu University, 1968, p. 120.

CHANGES IN THE PROTEIN-BOUND AMINO-ACIDS OF TOMATO FRUITS UNDER PATHOGENESIS

THE investigations carried out by the authors[1] on the free amino-acids of healthy and diseased fruits of tomato (*Lycopersicum esculentum* Mill.) infected with *Drachslera australiense* (Bugn.) Subram. and Jain indicated that in general, the amount of most of the free amino-acids increased in the infected tissues of the fruits. A further survey was undertaken to determine the changes in protein-bound amino-acids of healthy and diseased tomato fruits infected by the same organism.

Just ripe fruits of the same age were inoculated with *D. australiense* and were incubated at 25° ± 1° C. The extract of healthy/diseased tissues was made with ethanol after 10 days of infection. This ethanol extract was analysed chromatographically to determine the free amino-acid contents. For chromatographic assay of protein-bound amino-acids, the alcohol extracted residue, containing the protein nitrogen and the colloidal protein (left after centrifugation of soluble protein) were hydrolysed by 6 N HCl in the autoclave at 15 lb. pressure for 20 minutes. A pinch of stannous chloride was added to avoid humin formation and destruction of amino-acids in the presence of carbohydrates. The hydrolysed residue was filtered and the volume of hydrolyzate so obtained was adjusted to g./ml. fresh weight in 20% ethanol. The method followed for two-dimensional ascending chromatography was similar to that reported in earlier publication.[1] Proline, which gave a weak reaction with ninhydrin as a yellow spot, was confirmed by spraying with Isatin reagent of Saifer and Orekes.[2] The method for colorimetric estimation of the separated amino-acids and amides suggested by Thompson *et al.*[3] and also previously described by the authors[1] was followed. The results are summarized in Table I.

It is evident from Table I that leucine/isoleucine, α-alanine, glutamic acid, threonine, aspartic acid, serine/glycine, histidine/lysine were present both in healthy and diseased fruits, while analysis of the protein of the infected tomato fruits revealed the additional presence of valine, proline, arginine and glutamine. The concentration of all the bound amino-acids increased in the diseased tissues, and in this respect the results were similar to those reported by the authors for free amino-acids.[1] The conspicuous increase of the protein-bound amino-acids appears to be due to the association of fungal mycelium with the host tissue which is responsible for higher quantities of protein-bound amino-acids. An attempt was also made to determine if the organism could synthesize the various amino-acids and for this purpose the fungus was grown on modified Asthana and Hawker's liquid medium "A" in which glucose was substituted by 12 different sources of carbon. It was observed that the pathogen synthesized from 3 to 13 non-protein and 8 to 13 protein-bound amino-acids and amides. The synthesis of amino-acids and amides varied with the source of carbon.[4,5]

TABLE I

Showing protein-bound amino-acids and amides in healthy and infected tomato fruit (μg./gm. fresh weight)

Amino-acids		Protein-bound	
		Healthy	Infected
Leucine/isoleucine	..	60·0	80·0
Valine	..	—	60·0
Proline	..	—	260·0
α-alanine	..	60·0	440·0
Glutamic acid	..	60·0	240·0
Threonine	..	120·0	180·0
Arginine	..	—	360·0
Aspartic acid	..	140·0	360·0
Serine/glycine	..	260·0	480·0
Glutamine	..	—	60·0
Histidine/lysine	..	180·0	1160·0
Total	..	880·0	3680·0

—, indicates the absence of amino compound.

The financial assistance of the University Grants Commission as well as of the Council of Scientific and Industrial Research, New Delhi (India), is gratefully acknowledged.

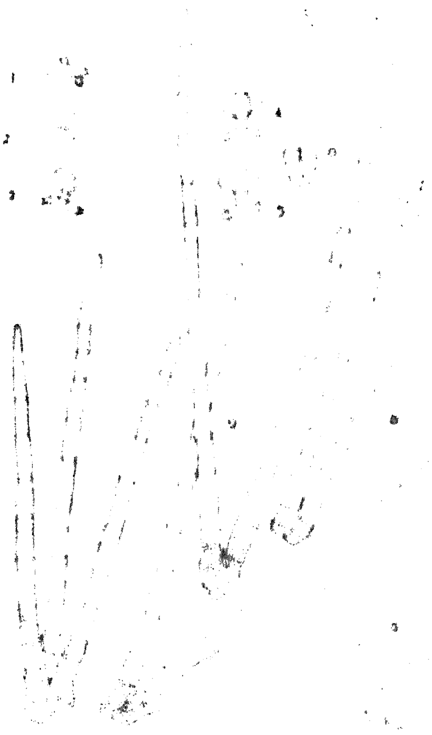
Botany Department, I. J. KAPOOR.
University of Allahabad, R. N. TANDON.
Allahabad-2 (India),
October 16, 1969.

---

1. Kapoor, I. J. and Tandon, R. N., *Naturwissenschaften*, 1969, **56**, 40.
2. Saifer, A. and Orekes, I., *Science*, 1954, **119**, 124.
3. Thompson, J. F., Zacharius, R. M. and Steward, F. C., *Plant Physiol.*, 1951, **26**, 375.
4. Kapoor, I. J., *D. Phil. Thesis*, University of Allahabad, India, 1968.
5. — and Tandon, R. N., *Flora*, 1969 (communicated).

A NEW CERATOSPORIUM FROM INDIA

[illegible]



[illegible]

This fungus produces [illegible] Hyderabad. [illegible] Mycelium superficial [illegible] septate, smooth, brown [illegible] late, thick walled, 3 [illegible] opposite and right angled branching. [illegible] phores are very short, peg-like, [illegible] on the superficial mycelium, subhyaline, smooth 1·4-4·2 μ long, 2·8-5·6 μ broad, (3·6 μ across [illegible] conidia [illegible] produced [illegible]

[illegible] has not [illegible] which [illegible] noted [illegible] Hughes, [illegible] Ceratosporium [illegible] Hughes, [illegible] septate conidia [illegible] placed laterally on the basal cell of the arm, therefore described now as new.

Type collected on the dead unidentified culms of monocot from Hyderabad on 27-12-1968,

CHANGES IN THE PROTEIN-BOUND AMINO-ACIDS OF TOMATO FRUITS UNDER PATHOGENESIS

THE investigations carried out by the authors[1] on the free amino-acids of healthy and diseased fruits of tomato (*Lycopersicum esculentum* Mill.) infected with *Drachslera australiense* (Bugn.) Subram. and Jain indicated that in general, the amount of most of the free amino-acids increased in the infected tissues of the fruits. A further survey was undertaken to determine the changes in protein-bound amino-acids of healthy and diseased tomato fruits infected by the same organism.

Just ripe fruits of the same age were inoculated with *D. australiense* and were incubated at 25° ± 1° C. The extract of healthy/diseased tissues was made with ethanol after 10 days of infection. This ethanol extract was analysed chromatographically to determine the free amino-acid contents. For chromatographic assay of protein-bound amino-acids, the alcohol extracted residue, containing the protein nitrogen and the colloidal protein (left after centrifugation of soluble protein) were hydrolysed by 6 N HCl in the autoclave at 15 lb. pressure for 20 minutes. A pinch of stannous chloride was added to avoid humin formation and destruction of amino-acids in the presence of carbohydrates. The hydrolysed residue was filtered and the volume of hydrolyzate so obtained was adjusted to g./ml. fresh weight in 20% ethanol. The method followed for two-dimensional ascending chromatography was similar to that reported in earlier publication.[1] Proline, which gave a weak reaction with ninhydrin as a yellow spot, was confirmed by spraying with Isatin reagent of Saifer and Orekes.[2] The method for colorimetric estimation of the separated amino-acids and amides suggested by Thompson *et al.*.[3] and also previously described by the authors[1] was followed. The results are summarized in Table I.

It is evident from Table I that leucine/isoleucine, α-alanine, glutamic acid, threonine, aspartic acid, serine/glycine, histidine/lysine were present both in healthy and diseased fruits, while analysis of the protein of the infected tomato fruits revealed the additional presence of valine, proline, arginine and glutamine. The concentration of all the bound amino-acids increased in the diseased tissues, and in this respect the results were similar to those reported by the authors for free amino-acids.[1] The conspicuous increase of the protein-bound amino-acids appears to be due to the association of fungal mycelium with the host tissue which is responsible for higher quantities of protein-bound amino-acids. An attempt was also made to determine if the organism could synthesize the various amino-acids and for this purpose the fungus was grown on modified Asthana and Hawker's liquid medium "A" in which glucose was substituted by 12 different sources of carbon. It was observed that the pathogen synthesized from 3 to 13 non-protein and 8 to 13 protein-bound amino-acids and amides. The synthesis of amino-acids and amides varied with the source of carbon.[4,5]

TABLE I

Showing protein-bound amino-acids and amides in healthy and infected tomato fruit (μg./gm. fresh weight)

Amino-acids		Protein-bound	
		Healthy	Infected
Leucine/isoleucine	..	60·0	80·0
Valine	..	—	60·0
Proline	..	—	260·0
α-alanine	..	60·0	440·0
Glutamic acid	..	60·0	240·0
Threonine	..	120·0	180·0
Arginine	..	—	360·0
Aspartic acid	..	140·0	360·0
Serine/glycine	..	260·0	480·0
Glutamine	..	—	60·0
Histidine/lysine	..	180·0	1160·0
Total	..	880·0	3680·0

—, indicates the absence of amino compound.

The financial assistance of the University Grants Commission as well as of the Council of Scientific and Industrial Research, New Delhi (India), is gratefully acknowledged.

Botany Department,
University of Allahabad,
Allahabad-2 (India),
October 16, 1969.

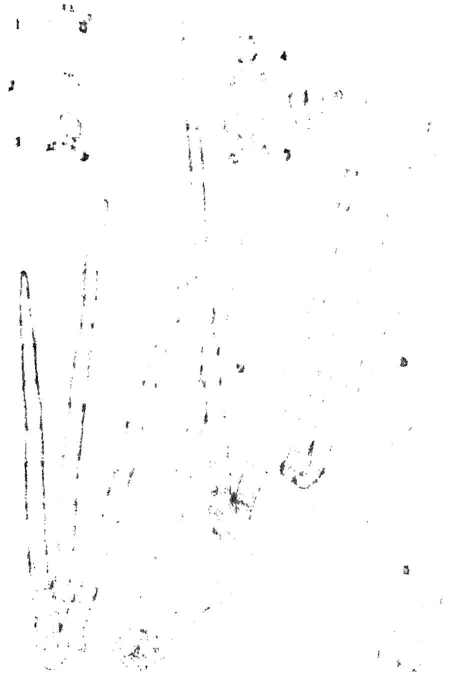
I. J. KAPOOR.
R. N. TANDON.

---

1. Kapoor, I. J. and Tandon, R. N., *Naturwissenschaften*, 1969, **56**, 40.
2. Saifer, A. and Orekes, I., *Science*, 1954, **119**, **124**.
3. Thompson, J. F., Zacharius, R. M. and Steward, F. C., *Plant Physiol.*, 1951, **26**, 375.
4. Kapoor, I. J., *D. Phil. Thesis*, University of Allahabad, India, 1968.
5. — and Tandon, R. N., *Flora*, 1969 (communicated).

A NEW CEPHALOSPORIUM FROM INDIA

[illegible]



[illegible]

[illegible] late, these [illegible] opposite and right angled [illegible] phialides are very short [illegible] on the superficial mycelium, [illegible] 1·4-4·2 μ long, 2·8-5·6 μ broad, [illegible] across [illegible]

[illegible] therefore described new as C. [illegible]

Type collected on the dead unidentified culms of monocot from Hyderabad on 27-12-1968,

CHANGES IN THE PROTEIN-BOUND AMINO-ACIDS OF TOMATO FRUITS UNDER PATHOGENESIS

THE investigations carried out by the authors[1] on the free amino-acids of healthy and diseased fruits of tomato (*Lycopersicum esculentum* Mill.) infected with *Drachslera australiense* (Bugn.) Subram. and Jain indicated that in general, the amount of most of the free amino-acids increased in the infected tissues of the fruits. A further survey was undertaken to determine the changes in protein-bound amino-acids of healthy and diseased tomato fruits infected by the same organism.

Just ripe fruits of the same age were inoculated with *D. australiense* and were incubated at 25° ± 1° C. The extract of healthy/diseased tissues was made with ethanol after 10 days of infection. This ethanol extract was analysed chromatographically to determine the free amino-acid contents. For chromatographic assay of protein-bound amino-acids, the alcohol extracted residue, containing the protein nitrogen and the colloidal protein (left after centrifugation of soluble protein) were hydrolysed by 6 N HCl in the autoclave at 15 lb. pressure for 20 minutes. A pinch of stannous chloride was added to avoid humin formation and destruction of amino-acids in the presence of carbohydrates. The hydrolysed residue was filtered and the volume of hydrolyzate so obtained was adjusted to g./ml. fresh weight in 20% ethanol. The method followed for two-dimensional ascending chromatography was similar to that reported in earlier publication.[1] Proline, which gave a weak reaction with ninhydrin as a yellow spot, was confirmed by spraying with Isatin reagent of Saifer and Orekes.[2] The method for colorimetric estimation of the separated amino-acids and amides suggested by Thompson *et al.*.[3] and also previously described by the authors[1] was followed. The results are summarized in Table I.

It is evident from Table I that leucine/isoleucine, α-alanine, glutamic acid, threonine, aspartic acid, serine/glycine, histidine/lysine were present both in healthy and diseased fruits, while analysis of the protein of the infected tomato fruits revealed the additional presence of valine, proline, arginine and glutamine. The concentration of all the bound amino-acids increased in the diseased tissues, and in this respect the results were similar to those reported by the authors for free amino-acids.[1] The conspicuous increase of the protein-bound amino-acids appears to be due to the association of fungal mycelium with the host tissue which is responsible for higher quantities of protein-bound amino-acids. An attempt was also made to determine if the organism could synthesize the various amino-acids and for this purpose the fungus was grown on modified Asthana and Hawker's liquid medium "A" in which glucose was substituted by 12 different sources of carbon. It was observed that the pathogen synthesized from 3 to 13 non-protein and 8 to 13 protein-bound amino-acids and amides. The synthesis of amino-acids and amides varied with the source of carbon.[4,5]

TABLE I

Showing protein-bound amino-acids and amides in healthy and infected tomato fruit (μg./gm. fresh weight)

Amino-acids		Protein-bound	
		Healthy	Infected
Leucine/isoleucine	..	60·0	80·0
Valine	..	—	60·0
Proline	..	—	260·0
α-alanine	..	60·0	400·0
Glutamic acid	..	60·0	240·0
Threonine	..	120·0	180·0
Arginine	..	—	360·0
Aspartic acid	..	140·0	360·0
Serine/glycine	..	260·0	480·0
Glutamine	..	—	60·0
Histidine/lysine	..	180·0	1160·0
Total	..	880·0	3080·0

—, indicates the absence of amino compound.

The financial assistance of the University Grants Commission as well as of the Council of Scientific and Industrial Research, New Delhi (India), is gratefully acknowledged.

Botany Department, I. J. KAPOOR.
University of Allahabad, R. N. TANDON.
Allahabad-2 (India),
October 16, 1969.

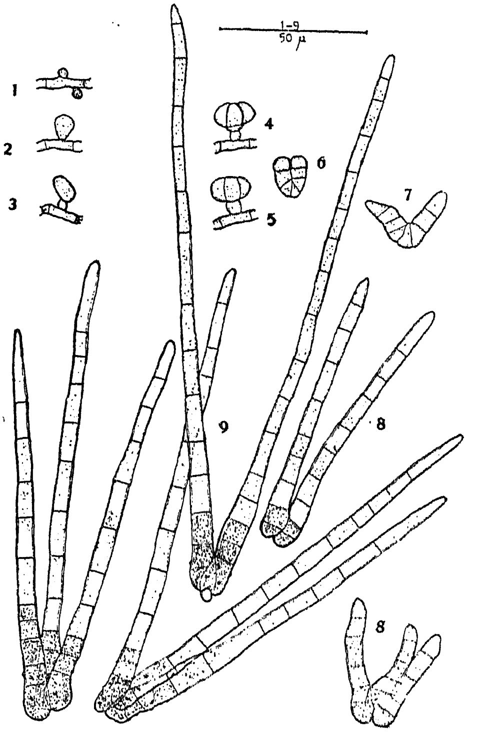
---

1. Kapoor, I. J. and Tandon, R. N., *Naturwissenschaften*, 1969, **56**, 40.
2. Saifer, A. and Orekes, I., *Science*, 1954, **119**, 124.
3. Thompson, J. F., Zacharius, R. M. and Steward, F. C., *Plant Physiol.*, 1951, **26**, 375.
4. Kapoor, I. J., *D. Phil. Thesis*, University of Allahabad, India, 1968.
5. — and Tandon, R. N., *Flora*, 1969 (communicated).

A NEW *CERATOSPORIUM* FROM INDIA

HUGHES (1951) redescribed *Ceratosporium fuscescens,* the type species of *Ceratosporium* Schw. (Schweineitz, 1834 ex Hughes, 1951) giving conidial development in it and *C. rilstonii* Hughes; and also discussed critically the other taxa described after Schweineitz under the name *Ceratosporium.* In this communication a new species of this Hyphomycete is being described.

Ceratosporium indica SP NOV. (FIGS. 1-7)



Ceratosporium indica sp. nov. (From type material V V.U. B. L. No 774).

FIGS. 1-9. Fig. 1. Part of mycelium with peg-like projections. Figs. 2-3. Development of conidial initial. Figs. 4-5. development of conidia by first and second method. Figs. 6-8. Young conidia. Fig. 9. Matured conidia.

This fungus produces superficial blackish-brown to black colonies on the substratum. Mycelium superficial or partly immersed, septate, smooth, brown to subhyaline, reticulate, thick-walled, 3·6–5·8 μ broad, often with opposite and right-angled branching. Conidiophores are very short, peg-like, arise singly on the superficial mycelium, subhyaline, smooth 1·4–4·2 μ long, 2·8–5·6 μ broad, (3·6 μ across) producing solitary conidia. The conidia (staurospores) consist of 2–3 long arms (rarely 4-armed), brown to blackish-brown. The arms are blackish brown at base gradually turn paler towards apex becoming subhyaline to hyaline, 14–23 septate, not constricted at the septa, basal cells thick-walled covered with distantly placed loose warts or smoth, arms adpressed, or loosely overlap each other at base and diverge in the upper region, straight or slightly flexuous, 140–378 μ long, 3·6–7·2 μ wide at base and upto 3·6 μ at apex. The conidia may or may not have basal cell depending on their mode of development.

Conidia develop from short narrow erect branch arising from the superficial mycelium in no order. The apex of each branch swells into a spherical vesicle, 5·6–11·2 μ diam., which is cut off by a septum from the cylindrical stalk. This vesicle serves as the *conidial initial,* becomes brown and produces conidia in any of the two methods as described by Hughes (1951).

In the first method the initial may elaborate vertically or obliquely producing a transverse septum in which case the distal cell enlarges laterally in opposite direction becoming sausage-shaped, two cells are laid down giping 3 cells of which the two end cells initiate the two arms. The elongation occurs and further septa are formed during which a third arm may develop from the distal cell or adjacent cell of the young arm. In the second method the initial enlarges laterally in opposite directions and become oval or sausage-shaped. Septa arise at each side of its attachment to the stalk thus producing 3 cells. The two arms of the conidia are initiated and further development is similar to the first. The third arm is more usually produced in this method of conidial formation. Conidia formed by the first method conspicuously have the lower or basal cells resulting from the division of the conidial initial and it is absent in conidia developing by the second method.

The secondary conidial apparatus has not been observed in our taxon, which was reported in *C. fuscescens* and *C. rilstonii* (Hughes, 1964). This taxon differs from other *Ceratosporium* species (Hughes, 1951; Saccardo, 1886) in having longest many septate conidia, and distantly placed loose warts on the basal cells of the arms, therefore, described new as *C. indica.*

Type collected on the dead unidentified culms of monocot from Hyderabad on 27-12-1968,

deposited at Herb: Hyderabadense V.V.C.B.L. No. 774.

Ceratosporium indica SP. NOV.

Coloniæ effusræ, pallide brunneæ vel atro brunneæ, superficialia, irregularia. Mycelium partim superficiale partim immersum ex hyphis brunneis, repentibus, septatis, rectis 3·6–5·8 μ latis, ramosis (90°), anastomosantibus compositum. Conidiophora brevissima, 1·4–4·2 μ longa, 2·8–5·6 μ lata (3·6 μ crassis) ex hyphis duobus vel tribus composita. Ramuli conidiorum basi coaliti, inferne adpressi sæpeque inter se subspirales, recti vel curvati, divergentes, vel fasciculares, brunnei et warticulata ad basin, superne subhyalina vel hyalina levia, 14–23 septati, 140–378 μ longi, 14·4–21·6 μ lati, apice 3·6–5·8 μ lati.

Sincere thanks are due to Mr. P. S. Rao, Principal, and Dr. S. D. Satwalekar, former Principal, Vivek Vardhini College, for facilities and encouragement.

Department of Botany,
Vivek Vardhini College,
Hyderabad (A.P.), India,
March 20, 1969.

VASANT RAO.
DEV RAO.

---

1. Hughes, S. J., *Mycol. Pap.* 1951, **39**, 9.
2. —, *N.Z. Jl. Bot.* 1964, **2**, **3**, 305.
3. Saccardo, P. A., *Sylloge Fungorum*, 1886, **4**, 533.

EPICOTYL GRAFTING IN MANGO (*MANGIFERA INDICA* L.)

INARCHING, a commercially adopted attached method of grafting in mango, is not only cumbersome and expensive but sometimes impraticable too, particularly when scion material is to be brought from distant places or from very high trees. Because of these reasons a successful detached grafting method was rightly desired in mango and veneer grafting has fulfilled the need.[2] Besides, other methods of detached grafting such as saddle, splice and wedge have been also tried with considerable success using the root-stocks upto one month age at this Institute since 1962. The splice grafting gave good success.[1] In continuation to the above, further work has been carried out by employing germinating seeds as root-stocks and grafting at its epicotyl portion.

Germinating seeds of about 4–8 days old were taken out from sand-beds in a water bucket avoiding injuries to roots and were used as root-stocks. The scions were prepared by prior defoliation of shoots of comparative thickness. Splice and wedge methods were used for grafting. For splice grafting, the epicotyl was cut in 2–3 cm. long slanting way and the lower portion of scion was also cut to match the same cut. The cut surfaces of both the stock and scion were tied together with alkathene so that the cambium of each other came in close contact. In wedge grafting, a vertical cut of 4–6 cm. length was given into the beheaded epicotyl so as to receive the wedge-shaped scion (Fig. 1). This was then tied tightly with alkathene film. The grafts prepared by above methods were planted immediately in pots and watered. The whole operation was conducted in rainy season when there was high humidity in the atmosphere.

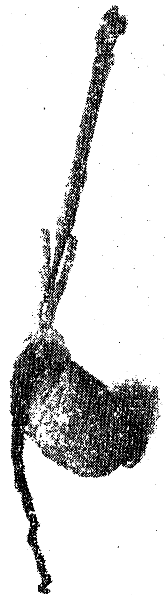


FIG. 1. Epicotyl grafting by wedge method, scion placed in position.

The scion sprouted within a month of operation. The percentages of success in splice and wedge methods were 50·0 and 33·3 respectively. Plants raised by splice method grew better than the others. These techniques will enable the nurserymen to prepare more grafts during rainy season.

Division of Horticulture,
Indian Agricultural
Research Institute,
New Delhi-12, *October* 28, 1969.

P. K. MAJUMDER.
D. S. RATHORE.

---

1. Anon, *IARI Ann. Sci. Rep.*, 1965, p. 124.
2. Mukherjee, S. K. and Majumder, P. K., *Indian Hort.*, 1961, **6**, 3.

REVIEWS AND NOTICES OF BOOKS

Annual Review of Astronomy and Astrophysics (Vol. 7). Edited by Leo Goldberg. (Annual Reviews, Inc., 4139 El Camino Way, Palo Alto, California 94306, U.S.A.), 1969. Pp. vii + 717. Price $ 8.50 U.S.A.; Foreign $ 9.00.

This latest volume of the *Annual Review of Astronomy and Astrophysics* was organized by the Editorial Committee during its seventh meeting in Palo Alto, California, on May 20, 1967. Attempts have been made to provide the reader with a series of critical reviews covering research in a number of important fields of astronomy and astrophysics.

The articles contained in this volume are: Cosmic Rays in the Galaxy, by Peter Meyer; The Large-Scale Distribution of Hydrogen in the Galaxy, by Frank J. Kerr; Evolution of Diffuse Nebulæ, by William G. Mathews and C. R. O'Dell; Lithium and Beryllium in Stars, by George Wallerstein and Peter S. Conti; X-Rays from the Sun, by W. M. Neupert; Mechanisms of Solar Flares, by P. A. Sweet; The Interiors of Planets, by K. E. Bullen, Radar Studies of Planetary Surfaces, by J. V. Evans; Infrared Spectra of Stars, by Hyron Spinrad and Robert F. Wing; Motions of Planetary Atmospheres, by Richard Goody; Synthetic-Aperture Radio Telescopes, by G. W. Swenson, Jr.; Developments in the Theory of Synchroton Radiation and Its Reabsorption, by V. L. Ginzburg and S. I. Syrovatskii; Ultraviolet Astronomy, by R. Wilson and A. Boksenberg; The Moon's Surface, by Ernst J. Optik; Quasistellar Objects, by Maarten Schmidt; Physics of Massive Objects, by Robert V. Wagoner; The Magnetosphere of Jupiter, by Thomas D. Carr and Samuel Gulkis; High-Resolution Observations of Radio Sources, by Marshall H. Cohen; Stellar Rotation, by P. A. Strittmatter; and Some Related Articles Appearing in other *Annual Reviews.* C. V. R.

Biophysics: Concepts and Mechanisms. By E. J. Casey. (Van Nostrand Reinhold Co., New York, London, Toronto, Melbourne) (Affiliated East-West Press, Pvt. Ltd., New Delhi), 1969. Pp. xvi + 335. Price Rs. 16·00.

This book is primarily intended to provide the student of biological sciences or of medicine with a substantial introduction into Biophysics. The subject-matter, discussed in the Introduction, has been carefully chosen during ten years of teaching the subject.

Richly illustrated, the book presents a readable coverage of such important topics as bioenergetics, kinetics, information theory, ultrasonics, radioactivity and ionizing radiations, and structure of macromolecules and of membranes. The author presents each subject as a functional part of an integrated whole. Interactions between electromagnetic radiations and the human body are presented systematically as parts of the spectrum (warming, visible, photochemical and ionizing regions).

The treatment of energy transfer, and nerve and muscle lead logically into a discussion of coding and information theory in genetics and self-control of the living organism. The scope is broad, yet fully detailed in those areas where quantitative knowledge of living systems is extensive enough to allow a treatment in depth.

This book will serve as a convenient and valuable treatment of biophysics for professional people and students in medicine, biology, physics, and other fields concerned with the quantitative physical aspects and modern concepts of biological structures and processes.

C. V. R.

Applied Spectroscopy Reviews (Vol. 2). Edited by Edward G. Brame, Jr. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. vii + 376. Price $ 17.50; In sterling: £ 8.7 *sh.* 0 *d.*

Applied Spectroscopy Reviews provides the latest information on principles, methods, and applications of spectroscopy for the researcher, with discussions that relate physical concepts to chemical applications. Written by noted spectroscopists, the articles cover the entire field of spectroscopy, so that chemists, physicists, biochemists, and other scientists who use spectroscopy in their research may benefit from the material presented. Gamma-ray, X-ray, ultraviolet, emission, visible, infrared, Raman, microwave, NMR, ESR, NQR, mass, atomic absorption, and internal reflection spectroscopy are among the methods which are examined. Recent advances in the field are reviewed, assessed, and critically evaluated, with emphasis on the application of the latest techniques. The underlying principles of these techniques and applications are also discussed.

Volume 2 under review contains the following chapters: Near-Infrared Spectrophotometry, by Kermit B. Whetsel; Spectroscopic Studies of the Hydrogen Bond, by A. S. N. Murthy and C. N. R. Rao; Molecular Vibrations of High Polymers, by Giuseppe Zerbi; and Analysis of ABX Spectra in NMR Spectroscopy, by George Slomp.

Organic chemists, biochemists, spectroscopists, and students and teachers in various fields will find this book required reading. C. V. R.

Fundamentals of Electrodynamics. By Boris Podolsky and Kaiser S. Kunz. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), P. 492. Price $ 14.50.

The book treats classical electrodynamics in a logically consistent way so as to prepare the student for quantum electrodynamics, elementary particle physics, and quantum field theory. The text is broad based and covers in addition to basic theory, applications to radiation theory, geometrical optics, breadth of spectral lines, dynamics of charged particles, and electrodynamics of material media. There are worked out examples as well as problems at the end of each chapter. The book should be suitable for a one semester course in classical electrodynamics to graduate physics students.

A. S. G.

A Laboratory Manual of Microtechnique and Histochemistry. By A. T. Sumner and B. E. H. Sumner. (Published by Blackwell Scientific Publications, 5, Alfred Street, Oxford OX 1 4 HB. England), Pp. 98. Price 20 *sh*.

This manual is intended as an introduction to the field of practical microtechnique and histochemistry of animal tissues. Though the book is particularly suited to under-graduates, it will also be useful to those research workers whose main interests lie in other fields, but may occasionally need cytological or histochemical information about their animals. The selection of methods is such as to help the non-specialists also. A. S. G.

Supplement to the Glossary of Indian Medicinal Plants. By R. N. Chopra, I. C. Chopra and B. S. Varma. (Publications and Information Directorate, Hillside Road, New Delhi-12), Pp. 120. Price Rs. 14·00; 28 *sh*. or $ 4.50.

Since the publication of the original book *The Glossary of Indian Medicinal Plants* in 1956, a considerable amount of work has been done on medicinal plants and a large volume of literature has accumulated. The present *Supplement* contains information on the subject published between 1955 and 1964, and thus brings the Glossary more up to date.

A. S. G.

Vanaspatika Anusandhana Darsika (in Hindi). By K. C. Chunekar. (Chowkhamba Sanskrit Series Office, Post Box 8, Varanasi-1 U.P), Pp. 192. Price Rs. 10·00.

This publication in Hindi contains the abstracts of more than 700 research papers on Indian medicinal plants published during the three years 1966–68, from the fields of pharmacognosy, phytochemistry, pharmacology, and clinical trials. Relevant information is given under each plant arranged in alphabetical order according to their scientific names in English. A. S. G.

Books Received

Graph Theory. By Frank Harary. (Addison-Wesley Publishing Co., Inc., London W. 1), 1969. Pp. ix + 274. Price 117 *sh*.

Concepts and Development of Quantum Physics By J. C. Slater. (Dover Publications, 180, Varick Street, New York 10014), Pp. xi + 322. Price $ 3.00.

J. Sen Memorial Volume. Edited by H. Santapau, A. K. Ghosh, S. K. Roy, S. Chandra and S. K. Chaudhuri. (Botanical Society of Bengal, 35, Ballygunge Circular Road, Calcutta-19), 1969. Pp. xxi + 497. Price Rs. 40·00.

1862–70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

MICRONUTRIENTS IN NITROGENOUS, PHOSPHATIC AND MIXED FERTILIZERS

K. T. JOSEPH, M. PARAMESWARAN AND S. D. SOMAN

Health Physics Division, Bhabha Atomic Research Centre, Bombay-85

INTRODUCTION

IN plant nutrition, besides carbon dioxide and water some other materials are also essential. Among them are: (*a*) The macronutrients nitrogen, phosphorus and potassium which are required by the plants in large quantity, (*b*) the secondary nutrients calcium, magnesium and sulphur which are required in lesser but still considerable quantity, (*c*) the micronutrients (trace elements) iron, manganese, copper, zinc, boron, molybdenum and chlorine, the requirements, of which are in extremely small quantity. The role of CO_2, water, macronutrients as well as secondary nutrients in plant growth are well known.[1] But, comparatively little information is available on the role of trace elements in plant nutrition. Presently, it is known that Fe is used by the plant in some of its respiratory enzyme systems like catalase and peroxidase. Besides, being essential in chlorophyll formation (though not a constituent of it), Fe deficiency causes leaves to turn white and results in retardation of growth. Zn is considered to be involved in certain enzyme systems in the plants like carbonic anhydrase and carboxylase. It is also associated with auxin, a growth-promoting hormone. Mn plays some unknown part in the functioning of certain oxidative enzyme systems as well as arginase and carboxylase groups. Cu is also probably associated with some of the plant enzyme systems such as polyphenol oxidase, laccase and ascorbic acid oxidase. In addition to the above-mentioned elements, it is possible that some more elements may be identified as essential elements and Rb is likely to be one among such elements.

The supply of macronutrients is the primary function of fertilizer industry. The requirement of secondary nutrients is usually met by incidental inclusion of these elements in major nutrient fetilizers. The occurrence of trace elements in fertilizers may be either accidental or due to their deliberate addition as micronutrients. As impurities in raw materials and during different stages of manufacturing processes, some of these elements find their way to the finished products.

The present work is based on the analysis of certain nitrogenous, phosphatic and mixed fertilizers for K, Rb, Mg, Fe, Cu, Mn and Zn by Atomic Absorption Spectrophotometry.

EXPERIMENTAL

The nitrogenous fertilizer (ammonium sulphate and urea) samples were brought into solution by dissolving in distilled deionised water. The phosphatic and mixed fertilizer samples were dissolved by two different digestion methods: (*a*) Digestion with conc. HCl and (*b*) digestion with HF-HNO_3 (1 : 2). In each case a weighed quantity of the sample (~ 5 g.) was used and the solution made up to 100 ml. in a volumetric flask. Appropriate "blanks" were also prepared by adding only the respective reagents.

A Perkin-Elmer model 303 Atomic Absorption Spectrophotometer with Air-Acetylene flame was used for all the determinations. All the elements except K and Mg were determined directly in the sample solutions. K and Mg in phosphatic and mixed fertilizers were determined after suitable dilution (10 to 100 times) of the sample solutions. Usual precautionary steps were taken to avoid possible interference effects.[2-4] Considering the high solid contents in the sample solutions prepared, corrections were made in absorbance values for light scattering as suggested by Billings.[5]

RESULTS AND DISCUSSION

The precision and accuracy of the determinations were checked by duplicate analysis and by adopting method of standard addition, and found to be within 2% and 5% respectively. Table I lists the sensitivity of determination

TABLE I

Sensitivity and minimum sample concentration that could be estimated*

Element		Sensitivity	Minimum determinable sample concentration (μg/g)
Calcium	..	0·45	0·9
Magnesium	..	0·02	0·04
Potassium	..	0·09	0·18
Rubidium	..	0·33	0·66
Iron	..	0·3	0·66
Copper	..	0·14	0·28
Zinc	..	0·175	0·35
Manganese	..	0·15	0·3

* μg/ml of element which gives 1% absorption.

TABLE II (*a*)

Concentration of various elements in nitrogenous fertilizers

Fertilizer	Sample treatment	μg/g. of the sample						
		Mg	K	Fe	Zn	Cu	Mn	Rb
Ammonium sulphate (F.A.C.T.) ..	Water dissolution	2	1	2·1	0·8	0·9	1·1	4·5
Ammonium sulphate (Gujarat fertilizers)	”	4	0·5	1·8	0·6	2	0·8	3·2
Urea (Gujarat fertilizers) ..	”	2	1·2	1·6	<0·35	2	0·6	4

TABLE II (*b*)

Concentration of various elements in phosphatic and mixed fertilizers

Fertilizer	Sample treatment	% of the sample			μg/g. of the sample			
		Mg	K	Fe	Zn	Cu	Mn	Rb
Super phosphate (F.A.C.T.)	HCl digestion	0·1243	0·0155	0·1090	112	13	9	1·9
	$HF-HNO_3$ digestion	0·0400	..	0·0415	145	8	6	1·2
Diammonium phosphate (Gujarat fertilizers)	HCl digestion	0·2514	0·0402	..	402	14	99	1·2
	$HF-HNO_3$ digestion	0·0908	0·0343	0·2690	212	14	95	1·1
Factumfos (F.A.C.T.)	HCl digestion	0·1470	0·0098	0·0960	96	6	6·2	1·2
	$HF-HNO_3$ digestion	0·1030	0·0088	0·0990	106	6	7·9	1·1
Suphala (F.C.I. Trombay)	HCl digestion	0·3290	..	0·5125	38	10	57	30
	$HF-HNO_3$ digestion	0·1370	..	..	32	9	66	22·6

for different elements and minimum sample concentration in each case that could be estimated. Tables II (*a*) and II (*b*) report the concentration of various elements in nitrogenous, phosphatic and mixed fertilizer samples analysed. Of the two methods followed for phosphatic and mixed fertilizers, the values obtained by HCl digestion procedure are generally higher in case of K, Mg and Fe. For the rest of the elements, except Zn, the values obtained by both the methods agree well. No such generalization is possible in case of values for Zn from the results obtained. Hammar and Page who estimated micronutrients in fertilizers[6] favour HCl digestion method after trying $KHSO_4$ fusion, $HF-HNO_3$ digestion and HCl digestion methods. The data presented in Table II (*a*) show that the nitrogenous fertilizers analysed are deficient not only in micronutrients but also in K and Mg. Deficiencies of micronutrients are observed in the other two types of fertilizers also (Table II *b*).

Some of the typical guarantee values proposed and adopted by regulation in some states of U.S.A. are given in Table III. Unfortunately, the beneficial role of micronutrients added to fertilizers does not seem to be appreciated by the manufacturers in our country. It is desirable that quality control measures with regard to micronutrient content are strictly followed as is the case in U.S.A., where fertilizer manufacturers give guarantee values of these elements in their products.[6] It may be argued that the requirement of these elements by plants could be met with what is present in the soil and the range between adequate and toxic levels of micronutrients (like B, Zn and Cu) are small so that additional supply of the trace elements through fertilizers is not necessary. But, it is pointed out[1] that the dependence on incidental supply or, on materials already present in the soil, is not often adequate for optimum plant growth. Besides, the micronutrients which are already present in the soil are not readily available to the plant. Therefore, not only the supply of these nutrients, but also that in the available form (Cu, Zn,

TABLE III

**Typical guarantee values of certain micronutrients (Proposed and adopted by some states in U.S.A.)*

Element	Per cent
Mg	0·50
Cu	0·05
Fe	0·10
Mn	0·05
Zn	0·05

* Reported in Ref. (1).

Micro[illegible] [illegible] ally. The view that micronutrients should be supplied at calculated [illegible] whether a need can be identified [illegible] support among agronomists.

Considering the problem of uniform distribution of micronutrients in fertilisers, analysis of random bulk samples for their trace element content would be [illegible] as one of the quality control measures in fertiliser industries.

ACKNOWLEDGEMENTS

The authors wish to express their thanks to Dr. A. K. Ganguly, Head, Health Physics Division, B.A.R.C., for his interest in the work and encouragement. Thanks are also due to the [illegible] who responded to our request by sending the samples for analysis.

1. Kirk Othmer, *Encyclopedia of Chemical Technology*, 2nd Completely Revised Edition, Interscience Publishers, 1966, **9**, 25.
2. *Analytical Methods for Atomic Absorption Spectrophotometry*, Perkin-Elmer Corporation, Norwalk, Connecticut.
3. *Atomic Absorption Spectroscopy*, Juan Ramirez Muñoz, Elsevier Publishing Company, 1968.
4. McBride, C. H., "Determination of minor nutrients in fertilisers by Atomic Absorption Spectrophotometry," *At. Absorption Newsletter*, 1964, **3**, 11.
5. Billings, G. K., "Light scattering in trace element analysis by Atomic Absorption," *Ibid.*, 1965, **4**, 10.
6. Hammar, H. E. and Page, N. R., "Micronutrient analysis of fertilisers with special reference to frits," *Ibid.*, 1967, **6**, 2.

CRYSTAL STRUCTURES OF SOME ADDITION COMPOUNDS OF GLYCINE

[illegible] NARAYANAN* AND SHANTA VENKATA RAMAN
Department of Physics, University of Mysore, Mysore-6

INTRODUCTION

It is well known that glycine forms addition compounds with many inorganic salts. Even though the structure of glycine itself has been analysed in detail,[1] very little structural information is available on these addition compounds. Hence it was felt worthwhile to carry out a systematic study of the crystal structures of some of them to gather information regarding the orientation of the glycine unit in the different compounds and also to elucidate the nature of the hydrogen bonds present.

This note describes the main features of the structure of glycine molecule in three addition compounds of glycine viz., Diglycine barium chloride monohydrate, Diglycine strontium chloride trihydrate and Diglycine manganese chloride.

EXPERIMENTAL

The compounds were crystallised by slow evaporation of aqueous solution of glycine and the respective salt (barium chloride, strontium chloride and manganese chloride) in stoichiometric proportions. Morphological studies showed the crystals of barium and strontium compounds to belong to the orthorhombic system while the manganese compound crystallised in the triclinic class.

The cell dimensions of the three crystals were determined from oscillation and Weissenberg photographs taken with CuK$_\alpha$ radiation. The space groups were deduced from the symmetry of and the systematic absences in the respective X-ray diffraction patterns. The crystal data for all the three compounds are given in Table I. The present values for the

TABLE I

Crystal group		Barium compound Orthorhombic	Strontium compound Orthorhombic	Manganese compound Triclinic
Space group		$P_{2_1 n}$	P_{bcn}	P_1
Cell parameters	a	8·302 Å	16·32 Å	4·971 Å
	b	14·810 Å	9·34 Å	7·920 Å
	c	9·324 Å	8·26 Å	6·926 Å
	α	90°	90°	107°·43
	β	90°	90°	115°·96
	γ	90°	90°	87°
Unit cell volume Å³		1143·0	1261·0	234·6
Density (measured) gm./c.c.		2·2	1·90	1·94
Density (calculated) gm./c.c.		2·182	1·892	1·932
Molecules per unit cell		4	4	1

---

* Present address: Max Planck Institute, München, W. Germany.

TABLE II (*a*)

Concentration of various elements in nitrogenous fertilizers

Fertilizer	Sample treatment	μg/g. of the sample						
		Mg	K	Fe	Zn	Cu	Mn	Rb
Ammonium sulphate (F.A.C.T.) ..	Water dissolution	2	1	2·1	0·8	0·9	1·1	4·5
Ammonium sulphate (Gujarat fertilizers)	,,	4	0·5	1·8	0·6	2	0·8	3·2
Urea (Gujarat fertilizers) ..	,,	2	1·2	1·6	<0·35	2	0·6	4

TABLE II (*b*)

Concentration of various elements in phosphatic and mixed fertilizers

Fertilizer	Sample treatment	% of the sample			μg/g. of the sample			
		Mg	K	Fe	Zn	Cu	Mn	Rb
Super phosphate (F.A.C.T.)	HCl digestion	0·1243	0·0155	0·1090	112	13	9	1·9
	$HF-HNO_3$ digestion	0·0400	..	0·0415	145	8	6	1·2
Diammonium phosphate (Gujarat fertilizers)	HCl digestion	0·2514	0·0402	..	402	14	99	1·2
	$HF-HNO_3$ digestion	0·0008	0·0343	0·2690	212	14	95	1·1
Factumfos (F.A.C.T.)	HCl digestion	0·1470	0·0098	0·0960	96	6	6·2	1·2
	$HF-HNO_3$ digestion	0·1030	0·0088	0·0990	106	6	7·9	1·1
Suphala (F.C.I. Trombay)	HCl digestion	0·3290	..	0·5125	38	10	57	30
	$HF-HNO_3$ digestion	0·1370	..	..	32	9	66	22·6

for different elements and minimum sample concentration in each case that could be estimated. Tables II (*a*) and II (*b*) report the concentration of various elements in nitrogenous, phosphatic and mixed fertilizer samples analysed. Of the two methods followed for phosphatic and mixed fertilizers, the values obtained by HCl digestion procedure are generally higher in case of K, Mg and Fe. For the rest of the elements, except Zn, the values obtained by both the methods agree well. No such generalization is possible in case of values for Zn from the results obtained. Hammar and Page who estimated micronutrients in fertilizers[6] favour HCl digestion method after trying $KHSO_4$ fusion, $HF-HNO_3$ digestion and HCl digestion methods. The data presented in Table II (*a*) show that the nitrogenous fertilizers analysed are deficient not only in micronutrients but also in K and Mg. Deficiencies of micronutrients are observed in the other two types of fertilizers also (Table II *b*).

Some of the typical guarantee values proposed and adopted by regulation in some states of U.S.A. are given in Table III. Unfortunately, the beneficial role of micronutrients added to fertilizers does not seem to be appreciated by the manufacturers in our country. It is desirable that quality control measures with regard to micronutrient content are strictly followed as is the case in U.S.A., where fertilizer manufacturers give guarantee values of these elements in their products.[6] It may be argued that the requirement of these elements by plants could be met with what is present in the soil and the range between adequate and toxic levels of micronutrients (like B, Zn and Cu) are small so that additional supply of the trace elements through fertilizers is not necessary. But, it is pointed out[1] that the dependence on incidental supply or, on materials already present in the soil, is not often adequate for optimum plant growth. Besides, the micronutrients which are already present in the soil are not readily available to the plant. Therefore, not only the supply of these nutrients, but also that in the available form (Cu, Zn,

TABLE III

**Typical guarantee values of certain micronutrients (Proposed and adopted by some states in U.S.A.)*

Element	Per cent
Mg	0·50
Cu	0·05
Fe	0·10
Mn	0·05
Zn	0·05

* Reported in Ref. (1).

Mn, etc., as sulphates and B as borate) is necessary. The view that micronutrients should be supplied as "insurance" whether a need can be identified or not is gaining support among agronomists.

Considering the problem of uniform distribution of micronutrients in fertilizers, analysis of random batch samples for their trace element content could be adopted as one of the quality control measures in fertilizer industry.

ACKNOWLEDGEMENTS

The authors wish to express their thanks to Dr. A. K. Ganguly, Head, Health Physics Division, B.A.R.C., for his interest in the work and encouragement. Thanks are also due to the authorities of fertilizer factories who responded to our request by sending the samples for analysis.

---

1. Kirk-Othmer, *Encyclopedia of Chemical Technology*, 2nd Completely Revised Edition, Interscience Publishers, 1966, **9**, 25.
2. *Analytical Methods for Atomic Absorption Spectrophotometry*, Perkin-Elmer Corporation, Norwalk, Connecticut.
3. *Atomic Absorption Spectroscopy*, Juan Ramírez-Muñoz, Elsevier Publishing Company, 1968.
4. McBride, C. H., "Determination of minor nutrients in fertilizers by Atomic Absorption Spectrophotometry," *At. Absorption Newsletter*, 1964, **3**, 11.
5. Billings, G. K., "Light scattering in trace element analysis by Atomic Absorption," *Ibid.*, 1965, **4**, 10.
6. Hammar, H. E. and Page, N. R., "Micronutrient analysis of fertilizers with special reference to frits," *Ibid.*, 1967, **6**, 2.

CRYSTAL STRUCTURES OF SOME ADDITION COMPOUNDS OF GLYCINE

P. NARAYANAN* AND SHANTA VENKATA RAMAN
Department of Physics, University of Mysore, Mysore-6

INTRODUCTION

It is well known that glycine forms addition compounds with many inorganic salts. Even though the structure of glycine itself has been analysed in detail[1-4] very little structural information is available about these addition compounds. Hence, it was felt worthwhile to carry out a systematic study of the crystal structures of some of them to gather information regarding the orientation of the glycine units in its different compounds and also to elucidate the nature of the hydrogen bonds present.

This note describes the main features of the structure of glycine molecule in three addition compounds of glycine, *viz.*, Diglycine barium chloride monohydrate, Diglycine strontium chloride trihydrate and Diglycine manganese chloride.

EXPERIMENTAL

The compounds were crystallised by slow evaporation of aqueous solution of glycine and the respective salt (barium chloride, strontium chloride and manganese chloride) in stoichiometric proportions. Morphological studies showed the crystals of barium and strontium compounds to belong to the orthorhomic system while the manganese compound crystallised in the triclinic class.

Unit cell dimensions of the three crystals were determined from oscillation and Weissenberg photographs taken with CuK$_\alpha$ radiation. The space groups were deduced from the symmetry of and the systematic absences in the respective X-ray diffraction patterns. The crystal data for all the three compounds are given in Table I. The present values for the

TABLE I

		Barium compound	Strontium compound	Manganese compound
Crystal group		Orthorhombic	Orthorhombic	Triclinic
Space group		P_{bcn}	P_{bcn}	$P_{\bar{1}}$
Cell parameters	a	8·302 Å	16·52 Å	4·971 Å
	b	14·810 A	9·34 A	7·920 Å
	c	9·324 A	8·25 A	6·976 Å
	α	90°	90°	107°·43
	β	90°	90°	115°·96
	γ	90°	90°	87°
Unit cell volume Å^3		1143·0	1261·0	234·6
Density (measured) gm./c.c.		2·2	1·90	1·94
Density (calculated) gm./c.c.		2·182	1·892	1·932
Molecules per unit cell		4	4	1

---

* Present address: Max Planck Institute, München, W. Germany.

Mn compound are more accurate than those reported earlier. The densities were measured by flotation method as reported earlier.[5,6]

Intensities were recorded on multiple films using the equi-inclination Weissenberg technique. Complete 3-D data were collected for the layers

Hkl, H = 0,1,2,3,4 and 5 } for barium
hkL, L = 0,1,2,3,4 and 5 } compound,
and Hkl .. H = 0,1,2,3,4 and 5 } for strontium
hKl .. K = 0,1,2,3,4 and 5 } compound
and hkL .. L = 0,1,2,3 and 4 } for manganese
Hkl .. H = 0,1,2,3 and 4 } compound.

Intensities were measured by visual estimation against standard intensity strips recorded for the same crystals. The Lorentz, polarisation and absorption corrections were applied to the measured intensities and they were placed on an absolute scale using Wilson's procedure.

STRUCTURE DETERMINATION

All three structures have been determined by the heavy atom method. The first two structures (Ba and Sr compounds) are orthorhombic with space group P_{bcn} and contain four molecules in the unit cell whereas the last one (Mn compound) is triclinic with space group $P_{\bar{1}}$ and contains only one molecule in the unit cell.

1. *Ba Compound*

Interpretation of the (hko) and (okl) Patterson projections enabled the Ba atom to be fixed with certainty. The position of Ba was then refined by the method of least squares. From the final structure factors, phases for many reflections could be deduced with certainty. Then a Ba removed difference Fourier showed clearly the chlorine position which was then refined. By successive application of difference synthesis and structure factor calculation and also by using a wire model of the glycine molecule according to Marsh's[7] values, all the atoms of glycine could be located as also the water oxygen. With these atomic co-ordinates, 3-D data with 557 reflections were fed and a few cycles of least squares refinement were performed and the R-factor came down to 11·6%. The structure was still more refined giving anisotropic temperature factors and the R-factor was reduced to 8·6%.

2. *Sr Compound*

Sr compound crystallises with space group P_{bcn} but is not isomorphous with the Ba compound.

After locating the Sr atom from (hol) and (okl) Patterson maps, a few successive Fourier and difference Fourier syntheses enabled to locate all the atoms. The R-factor at this stage was 19%. Further refinement was done with 3-D data. With inclusion of anisotropic temperature factors, the R-factor came down to 7%.

3. *Mn Compound*

Mn compound crystallises in the triclinic system in which the possible space groups are P_1 and $P_{\bar{1}}$. Intensity statistics performed with an overall temperature factor of $B = 0{\cdot}956$ Å^2 favours a centric structure. This is also to be expected from other considerations. The crystal was therefore assigned to space group $P_{\bar{1}}$.

It is obvious that Mn occupies the origin (0,0,0). By the same procedure of iterative difference syntheses, all the atoms could be located. This gave an R-factor of 22·5%. When anisotropic temperature factors were included, a few cycles of least squares refinement brought down the R-factor to 10·8%.

To improve the accuracy of intensity measurements in order to draw more refined structural conclusions the intensities or reflections in all the three crystals were also measured using a Siemens 3-circle automatic single crystal diffractometer. This was made available to one of the authors (P.N.) through the kind courtesy of Prof. W. Hoppe of the Max Planck Institute to whom the authors' thanks are due.

MAIN FEATURES OF THE STRUCTURES

From the results it is observed that the glycine molecule is in zwitter ion form in all the three cases. The molecular form of the glycine molecule is almost the same in all the structures. The molecule is planar except for the nitrogen atom which deviates from the planarity by 0·158 Å in the Ba compound, 0·141 Å in the Sr compound and 0·703 Å in the Mn compound. Table II gives the values for

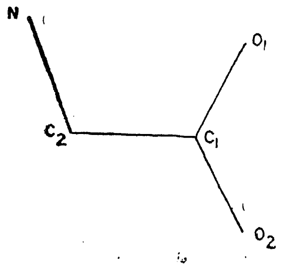


FIG. 1

TABLE II

Bond	Ba compound	Sr compound	Mn compound	Marsh α-glycine	Stosick Ni gly dihydrate
	Å	Å	Å	Å	Å
C_1–O_1	1·293	1·248	1·254	1·252	1·25
C_1–O_2	1·172	1·247	1·278	1·255	1·29
C_1–C_2	1·526	1·519	1·512	1·523	1·50
C_2–N	1·507	1·481	1·508	1·474	1·42
Bond angles					
O_1–C_1–O_2	124°·2	124°·2	124°·8	125°·5	122°
O_1–C_1–C_2	119°·8	119°·4	119°·5	117°·4	115°
O_2–C_1–C_2	116°·0	116°·4	115°·7	117°·1	123°
C_1–C_2–N	111°·7	111°·5	110°·5	111°·8	103°

the bond lengths and bond angles in the glycine molecule as revealed from the three structures as compared with those got for α-glycine by Marsh[7] and for Nickel Glycine dihydrate by Stosick.[8] The structures seem to be stabilised by a set of hydrogen bonds.

Details of the structure will be published in due course after completing the refinement with diffractometer data.

The authors wish to thank Prof. S. Chandrasekhar, for his continued interest in the problem.

1. Albrecht, G. and Corey, R. B., *J. Am. Chem. Soc.*, 1939, **61**, 1087.
2. Kitaigorodsky, A., *Act. Physicochim. U.R.S.S.*, 1936, **5**, 749.
3. Ksanda, C. J. and Tunnell, G., *Am. J. Sci.*, 1936, **35 A**, 173.
4. Iitaka, Y., *Act. Cryst.*, 1958, **11**, 225.
5. Narayanan, P. and Shanta Venkata Raman, *Curr. Sci.*, 1967, **36**, 315.
6. — and —, *Z. Kristallogr.*, 1967, **124**, 460.
7. Marsh, R. E., *Act. Cryst,*, 1958, **11**, 654.
8. Stosick, A. J., *J. Am. Chem. Soc.*, 1945, **67**, 365.

EFFECTS OF PHOTOPERIODISM ON MOULTING IN *HEMIGRAPSUS NUDUS* DANA

N. G. KURUP*

Department of Biology, University of Oregon, Eugene

and

Marine Biology Laboratory, Charleston, U.S.A.

ABSTRACT

In the shore crab, *Hemigrapsus nudus*, light as an environmental regulator of moulting is considered. Absence of light inhibits proecdysis, though increased light conditions do not accelerate it.

INTRODUCTION

LIGHT intensity and periodicity are known to influence crustacean moulting. There is evidence that moulting will be inhibited for several months in *Gecarcinus* if it is subjected to constant illumination (Bliss, 1954), but that darkness would favour its proecdysial growth (Bliss, 1964). *Cambarus* responds to daily photoperiod by an increased tendency to moult in winter months (Stephens, 1955). In *Carcinus* constant illumination retards moulting without affecting the duration of proecdysis (Passano, 1963). Kurup (1963) observed that, in *Hemigrapsus*, continuous illumination is not favourable for moult preparation, though prolonged darkness blocks moulting altogether. Controlled experiments, reported here, have further shown that moult responses of this shore crab, exposed to photoperiod, are considerably varied.

MATERIAL AND METHOD

Specimens of *Hemigrapsus nudus*, collected from Cape Arago, Oregon, U.S.A. were kept in aquarium tanks (2½′ × 2′ × 1½′) containing sand-beds with sea-water. The tanks were continually aerated and were supported on black-painted metal jackets of constant-running freshwater to simulate tide-pool conditions. A thermostat was also suitably installed to maintain a temperature range of 13–15° C. in the tanks. The water jackets were also provided with hinged light-proof lids having two 25-Watt fluorescent-lamp fixtures so as to produce 10–40 foot candles of illumination on the water surface in the tanks. The lights were controlled by automatic timers. The animals were fed with dog biscuits or fish scraps, and each day, the tanks were examined for food left overs and dead animals. The sand-beds were also cleaned and the sea-water changed on alternate days, the cleaning time never having exceeded 30 minutes for each tank. The stages of the crabs in the intermoult cycle were determined on the basis of criteria chosen from Kincaid and Scheer (1952), Scheer (1960) and Kurup (1964).

---

* Present address: Principal and Professor of Zoology, N.S.S. Hindu College, Changanacherry-2, Kerala.

The experiment was done in the winter months, November to December. Crabs in diecdysis (*See* Bliss, 1964) or belonging to C_4 stage (*See* Drach, 1939), of about the same size (3·20–3·60 cm. carapace width) were selected for the experiment, irrespective of sex (all females were non-ovigerous). They were divided into 5 groups (Groups A, B, C, D and E)—each group contained in a separate tank and each tank accommodating 9 animals—and then subjected to different photoperiod responses. Group E functioned as a control as those animals were subjected to 9 hours photoperiod which approximated with the normal daylength of the place in relation to season and latitude. The daylength had a maximum variance of 22 minutes only during the experimental period (Data from Coast and Geodetic Survey, U.S. Department of Commerce). The crabs were numbered on the carapace with a wax pencil to follow up the changes in the intermoult cycle individually. The Drach stages of the test animals were estimated and recorded for the days of the experiment (any time from 8 a.m. to 10 a.m.) and the results on the 12th and 30th days analysed.

RESULTS

Animals in Group A, kept in dark for full 24 hours a day did not show any proecdysial change even on the 30th day and 7 crabs survived the test period. Of the 9 crabs (Group B) maintained under 24-hour illumination, 3 changed themselves into D_0 by the 12th day. One more changed into D_0 by the 30th day, while proecdysis was not even initiated in the remaining 5. The maximum mortality was also observed in this group with only 3 animals (all in D_0) surviving the experimental period. In Group C subjected to 15-hour light and 9-hour dark each day, all the 9 animals were in D_0 on the 12th day; by the 30th day 3 crabs were in D_2 and 6 were in D_1, though 2 animals belonging to the D_1 stage died before completion of the experimental period. In Group D, to which light and dark alternated every 12 hours, 5 crabs showed no signs of proecdysis initiation till the 12th day, while 4 crabs moved on to the D_0 stage. By the 30th day, 3 animals (two in C_4 and one in D_0) were dead and the 6 survivors were all in D_0. Group E exposed to 9-hour light and 15-hour dark did not evince any response, and all the survivors (8 out of 9) remained in the C_4 stage even at the close of the experimental period. The one crab that died during the one-month observation was also in C_4.

For a quantitative assessment of moult induction, based on the results obtained for the 12th and the 30th days, a proecdysis index was calculated by the sum of the duration of stages of responsive animals (stage values) divided by the initial number of experimental animals of each group. The time run from one physiological state to another is approximately known (C_4 to D_0 = 15 days; D_0 to D_1 = 7 days; D_1 to D_2 = 6 days) for a closely related brachyuran genus belonging to the same *Grapsidæ* family, *Pachygrapsus* (Hiatt, 1948) and is applied here as the standard. As the intermoult specimens of *Hemigrapsus* and *Pachygrapsus* are about the same size, the duration of the intermoult cycle of these genera may not be varied (Scheer, 1960; Kurup, 1963). Accordingly, the total stage value of Group C, for example, can be worked out as under:

Days run by 9 C_4 crabs to reach $D_0 = 9 \times 15 = 135$

Days run by 6 D_0 crabs to reach $D_1 = 6 \times 7 = 42$

Days run by 3 D_1 crabs to reach $D_2 = 3 \times 6 = 18$

Total stage value = $135 + 42 + 18 = 195$

The total stage value (*i.e.*, 195) divided by the initial number of experimental animals in the group (*i.e.*, 9), which is 21·67, will be the proecdysis index for Group C. Likewise, the index for Group B and D works out to 6·67 and 11·67 respectively and that for A and E to zero. The results of the experiment, including percentage mortality and proecdysis index of the various groups are tabulated in Table I.

TABLE I

Group	Experimental state	Initial stage	Stage on 12th day	Stage on 30th day	Proecdysis index	Percentage mortality
A	24-hour dark	C_4	C_4	C_4	00·00	22·22
B	24-hour light	C_4	D_0	D_0	06·67	66·67
C	15-hour light	C_4	D_0	D_1-D_2	21·67	22·22
D	12-hour light	C_4	C_4-D_0	D_0	11·67	33·33
E	9-hour light	C_4	C_4	C_4	00·00	11·11

The data were analysed to test whether there is significant variation among the 5 treatments in so far as their effect on proecdysis index is concerned. The variation in the different stages is found significant at the 5% level. However, the treatments do not show significance and it may be due to non-availability of intermediate values. The analysis of variance is presented in Table II.

TABLE II

Source	S.s.	d.f.	m.s.	F calculated	F 5%
Treatments ..	110·10	4	27·5	2·34	3·84
Stages ..	120·80	2	60·4	5·16	4·46
Error ..	93·90	8	11·7	..	..
Total ..	324·80	14	..	..	..

DISCUSSION AND CONCLUSIONS

The mortality rates in the 5 groups of experimental animals are markedly different; the maximum mortality was observed at the maximum light conditions and the minimum at the shorter photoperiod (9-hour light) which corresponds to the normal daylength of the locality in winter months. Evidently, constant light is lethal to this crab, in spite of it initiating proecdysial responses. The animals are also more resistant to dark environs though it is not favourable to progress towards moult.

The experimental results also demonstrate that daily light ration does affect moulting in *Hemigrapsus*. In controls belonging to Group E (with 9-hour photoperiod) there is no indication of proecdysis and a stage change even in one animal has not been observed (all static at C_4) during the experiment. It might mean that at least in winter months (November to December) the intermoult cycle of this shore crab is longer, though in *Cambarus* the inclination to moult is only stronger in winter than in other seasons (Stephens, 1955). The maximal effect in *Hemigrapsus* is observed in the 15-hour light condition showing a proecdysial index of 21·67. However, the strength of the tendency to moult does not increase with increased light period in the crab; the 24-hour illumination did produce a proecdysis index of 6·7 only as against 11·67 by a 12-hour light period. This too is in contrast to the results on *Cambarus* (Stephens, 1955) where increased illumination was reported to have increased proecdysial changes. Again, continuous absence of light inhibits proecdysis in *Hemigrapsus*, though the condition obtained in *Gecarcinus* is just the reverse (Bliss, 1964). The results on *Hemigrapsus* indicate that the responses are quantitative in relation to photoperiod, a minimum threshold (somewhere between 9-hour and 12-hour daily light) needed to evoke a response notwithstanding. As moulting in crustaceans is controlled by the X-organ-Sinus gland-Y-organ complex (Kurup, 1963), it is also very likely that the pathway of photoperiodic moult induction is through the neuroendocrine system.

ACKNOWLEDGEMENT

The work embodied in this paper was done under the guidance of Professor Bradley T. Scheer in the Physiology Laboratories of the University of Oregon, Eugene and the Marine Biology Laboratory, Charleston during the author's tenure of a Fulbright-NSF associateship in U.S.A. It is a pleasure to thank Professor Scheer for his sustained help and interest in this investigation.

---

1. Bliss, D. E., *Anat. Record.*, 1954, **120,** 742.
2. —, *Gen. Comp. Endocrinol.*, 1964, **4,** 15.
3. Drach, P., *Ann. Inst. Oceanog.* (Paris), N S. **1939, 19,** 103.
4. Hiatt, R. W., *Pacific Sci.*, 1948, **2, 135.**
5. Kincaid, F. D. and Scheer, B. T., *Physiol. Zool.*, 1952, **25,** 372.
6. Kurup, N. G., *J. Anim. Morphol. Physiol.*, 1963, **10, 113.**
7. —, *Biol. Bull. Woodshole.*, 1964, **127,** 97.
8. Passano, L. M. and Jyssum, S., *Comp. Biochem. Physiol.*, 1963, **9,** 195.
9. Scheer, B. T., *Ibid.*, 1960, **1,** 3.
10. Stephens, G. C., *Biol. Bull. Woodshole*, 1955 **108,** 235.

vided with hinged light-proof lids having two 25-Watt fluorescent-lamp fixtures so as to produce 10–40 foot candles of illumination on the water surface in the tanks. The lights were controlled by automatic timers. The animals were fed with dog biscuits or fish scraps, and each day, the tanks were examined for food left overs and dead animals. The sand-beds were also cleaned and the sea-water changed on alternate days, the cleaning time never having exceeded 30 minutes for each tank. The stages of the crabs in the intermoult cycle were determined on the basis of criteria chosen from Kincaid and Scheer (1952), Scheer (1960) and Kurup (1964).

The experiment was done in the winter months, November to December. Crabs in diecdysis (*See* Bliss, 1964) or belonging to C_1 stage (*See* Drach, 1939), of about the same size (3·20–3·60 cm. carapace width) were selected for the experiment, irrespective of sex (all females were non-ovigerous). They were divided into 5 groups (Groups A, B, C, D and E)—each group contained in a separate tank and each tank accommodating 9 animals—and then subjected to different photoperiod responses. Group E functioned as a control as those animals were subjected to 9 hours photoperiod which approximated with the normal daylength of the place in relation to season and latitude. The daylength had a maximum variance of 22 minutes only during the experimental period (Data from Coast and Geodetic Survey, U.S. Department of Commerce). The crabs were numbered on the carapace with a wax pencil to follow up the changes in the intermoult cycle individually. The Drach stages of the test animals were estimated and recorded for the days of the experiment (any time from 8 a.m. to 10 a.m.) and the results on the 12th and 30th days analysed.

RESULTS

Animals in Group A, kept in dark for full 24 hours a day did not show any proecdysial change even on the 30th day and 7 crabs survived the test period. Of the 9 crabs (Group B) maintained under 24-hour illumination, 3 changed themselves into D_0 by the 12th day. One more changed into D_0 by the 30th day, while proecdysis was not even initiated in the remaining 5. The maximum mortality was also observed in this group with only 3 animals (all in D_0) surviving the experimental period. In Group C subjected to 15-hour light and 9-hour dark each day, all the 9 animals were in D_0 on the 12th day; by the 30th day 3 crabs were in D_2 and 6 were in D_1, though 2 animals belonging to the D_1 stage died before completion of the experimental period. In Group D, to which light and dark alternated every 12 hours, 5 crabs showed no signs of proecdysis initiation till the 12th day, while 4 crabs moved on to the D_0 stage. By the 30th day, 3 animals (two in C_4 and one in D_0) were dead and the 6 survivors were all in D_0. Group E exposed to 9-hour light and 15-hour dark did not evince any response, and all the survivors (8 out of 9) remained in the C_4 stage even at the close of the experimental period. The one crab that died during the one-month observation was also in C_4.

For a quantitative assessment of moult induction, based on the results obtained for the 12th and the 30th days, a proecdysis index was calculated by the sum of the duration of stages of responsive animals (stage value) divided by the initial number of experimental animals of each group. The time run from one physiological state to another is approximately known (C_4 to D_0 = 15 days; D_0 to D_1 = 7 days; D_1 to D_2 = 6 days) for a closely related brachyuran genus belonging to the same *Grapsidœ* family, *Pachygrapsus* (Hiatt, 1948) and is applied here as the standard. As the intermoult specimens of *Hemigrapsus* and *Pachygrapsus* are about the same size, the duration of the intermoult cycle of these genera may not be varied (Scheer, 1960; Kurup, 1963). Accordingly, the total stage value of Group C, for example, can be worked out as under:

Days run by 9 C_4 crabs to reach $D_0 = 9 \times 15 = 135$

Days run by 6 D_0 crabs to reach $D_1 = 6 \times 7 = 42$

Days run by 3 D_1 crabs to reach $D_2 = 3 \times 6 = 18$

Total stage value $= 135 + 42 + 18 = 195$

The total stage value (*i.e.*, 195) divided by the initial number of experimental animals in the group (*i.e.*, 9), which is 21·67, will be the proecdysis index for Group C. Likewise, the index for Group B and D works out to 6·67 and 11·67 respectively and that for A and E to zero. The results of the experiment, including percentage mortality and proecdysis index of the various groups are tabulated in Table I.

TABLE I

Group	Experimental state	Initial stage	Stage on 12th day	Stage on 30th day	Proecdysis index	Percentage mortality
A	24-hour dark	C_4	C_4	C_4	00·00	22·22
B	24-hour light	C_4	D_0	D_0	06·67	66·67
C	15-hour light	C_4	D_0	D_1-D_2	21·67	22·22
D	12-hour light	C_4	C_4-D_0	D_0	11·67	33·33
E	9-hour light	C_4	C_4	C_4	00·00	11·11

The data were analysed to test whether there is significant variation among the 5 treatments in so far as their effect on proecdysis index is concerned. The variation in the different stages is found significant at the 5% level. However, the treatments do not show significance and it may be due to non-availability of intermediate values. The analysis of variance is presented in Table II.

TABLE II

Source	S.s.	d.f.	m.s.	F calculated	F 5%
Treatments ..	110·10	4	27·5	2·34	3·84
Stages ..	120·80	2	60·4	5·16	4·46
Error ..	93·90	8	11·7	..	..
Total ..	324·80	14	..	..	..

DISCUSSION AND CONCLUSIONS

The mortality rates in the 5 groups of experimental animals are markedly different; the maximum mortality was observed at the maximum light conditions and the minimum at the shorter photoperiod (9-hour light) which corresponds to the normal daylength of the locality in winter months. Evidently, constant light is lethal to this crab, in spite of it initiating proecdysial responses. The animals are also more resistant to dark environs though it is not favourable to progress towards moult.

The experimental results also demonstrate that daily light ration does affect moulting in *Hemigrapsus*. In controls belonging to Group E (with 9-hour photoperiod) there is no indication of proecdysis and a stage change even in one animal has not been observed (all static at C_4) during the experiment. It might mean that at least in winter months (November to December) the intermoult cycle of this shore crab is longer, though in *Cambarus* the inclination to moult is only stronger in winter than in other seasons (Stephens, 1955). The maximal effect in *Hemigrapsus* is observed in the 15-hour light condition showing a proecdysial index of 21·67. However, the strength of the tendency to moult does not increase with increased light period in the crab; the 24-hour illumination did produce a proecdysis index of 6·7 only as against 11·67 by a 12-hour light period. This too is in contrast to the results on *Cambarus* (Stephens, 1955) where increased illumination was reported to have increased proecdysial changes. Again, continuous absence of light inhibits proecdysis in *Hemigrapsus*, though the condition obtained in *Gecarcinus* is just the reverse (Bliss, 1964). The results on *Hemigrapsus* indicate that the responses are quantitative in relation to photoperiod, a minimum threshold (somewhere between 9-hour and 12-hour daily light) needed to evoke a response notwithstanding. As moulting in crustaceans is controlled by the X-organ-Sinus gland-Y-organ complex (Kurup, 1963), it is also very likely that the pathway of photoperiodic moult induction is through the neuro-endocrine system.

ACKNOWLEDGEMENT

The work embodied in this paper was done under the guidance of Professor Bradley T. Scheer in the Physiology Laboratories of the University of Oregon, Eugene and the Marine Biology Laboratory, Charleston during the author's tenure of a Fulbright-NSF associateship in U.S.A. It is a pleasure to thank Professor Scheer for his sustained help and interest in this investigation.

---

1. Bliss, D. E., *Anat. Record.*, 1954, **120, 742.**
2. —, *Gen. Comp. Endocrinol.*, 1964, **4,** 15.
3. Drach, P., *Ann. Inst. Oceanog.* (Paris), N S. **1939, 19,** 103.
4. Hiatt, R. W., *Pacific Sci.*, 1948, **2, 135.**
5. Kincaid, F. D. and Scheer, B. T., *Physiol. Zool.*, 1952, **25,** 372.
6. Kurup, N. G., *J. Anim. Morphol. Physiol.*, 1963, **10, 113.**
7. —, *Biol. Bull. Woodshole.*, 1964, **127,** 97.
8. Passano, L. M. and Jyssum, S., *Comp. Biochem. Physiol.*, 1963, **9,** 195.
9. Scheer, B. T., *Ibid.*, 1960, **1, 3.**
10. Stephens, G. C., *Biol. Bull. Woodshole*, 1955 **108,** 235.

LETTERS TO THE EDITOR

THE CRYSTAL STRUCTURE OF RUBIDIUM SALT OF HOMOPHTHALIC ACID

As part of a programme for studying the structures of simple organic acids and their salts and the scheme of hydrogen bonding in these structures, we have been studying for some time homophthalic (α-2-toluene dicarboxylic) acid,[1] $C_9H_8O_4$, in this laboratory. During the early stages of our work, the relative orientations of the two COOH groups in the acid were entirely unknown and considerations of steric hindrances and packing in the unit cell left us several different models of the acid molecule. We, therefore, thought it worthwhile to get the skeletal arrangement of the homophthalate group itself by introducing a heavy atom in the carboxyl group and try the well-known heavy atom technique in crystallography for the structure determination. Our preliminary results are interesting and are being reported here.

There are two carboxyl groups in this molecule and depending upon the pH values of the solutions, one would expect for a dicarboxylic acid, either an 'acid' salt or a neutral salt of the acid. However, reactions with stoichiometric amounts of reacting substances do not yield the desired compounds. This has been reported by Gupta *et al.*[2,3] earlier for other dicarboxylic acids also.

In this particular case, chemical considerations favour simultaneous ionization of both the COOH groups leading to the formation of a neutral salt. But we find that stoichiometric proportions of the reacting substances (acid + rubidium carbonate), in a water solution, yield crystals, the chemical composition of which could be written down only as $C_9H_7O_4 . \frac{1}{2}Rb$, *i.e.*, per homophthalic acid molecule, there is associated only 'half rubidium' atom.

As this raised interesting points of structural chemistry (*viz.*, whether both the COOH groups are ionized or only one is ionized and the function and disposition of the heavy atom relative to the carboxyl groups), we have completed an X-ray examination of these crystals as well.

X-Ray Data.—X-ray diffraction data with single crystals show them to be monoclinic with

$a = 32 \cdot 35$ Å
$b = 5 \cdot 47$ Å
$c = 9 \cdot 96$ Å
$\beta = 95° \; 54'$
$\rho_{obs} = 1 \cdot 67_3$ gm./ml.

With the above value of observed density, the total unit cell content is 1771 (a.m.u.). For the empirical formula $C_9H_7O_4 . \frac{1}{2}Rb$ and eight such asymmetric units in the cell the expected value is 1774 (a.m.u.). We have ruled out completely the possibility of water of crystallization in the structure from a structure determination.

Space Group Absences.—

hkl only when $h + k = 2n + 1$
hol only when $l = 2n + 1$
okl only when $k = 2n + 1$
hoo only when $(h = 2n + 1)$

This fixes the space group uniquely as C2/c with eight general positions. As the asymmetric unit formula is $C_9H_7O_4 . \frac{1}{2}Rb$ and there are eight general positions, there would be only four heavy atoms in the structure and these must occupy special positions. We have completed a Fourier analysis of the zonal data *hol*, *hko*, the Fourier looking down the [010] axis being shown in Fig. 1. The orientation of the molecule and the positions of the heavy atoms have been confirmed again by the other projection. The least-squares refined data, with only overall isotropic temperature factor, for the projections gives R(*hol*) = 0·19, R(*hko*) = 0·21.

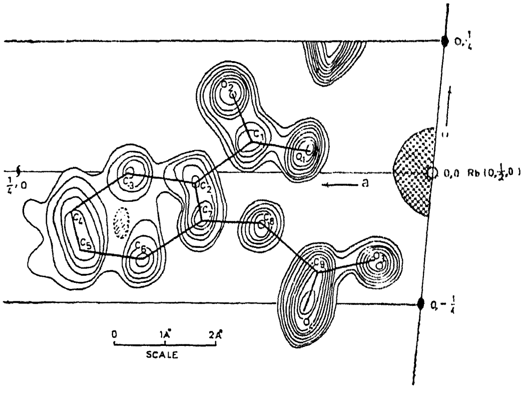


FIG. 1. Electron density projected down the [010] axis showing one molecule.

As there is considerable overlap in the other two projections and the interesting points of structural chemistry cannot be settled without a complete three-dimensional analysis leading to accurate values of the bond lengths and angles, we are doing a three-dimensional least-squares refinement of the X-ray data, the results of which will be published later.

Department of Physics, M. P. Gupta.
University of Ranchi, D. S. Dubey.
Ranchi-8, Bihar, India,
November 10, 1969.

---

1. Gupta, M. P. and Bose, S., *Ind. J. Phys.*, 1969, **43, 45.**
2. — and Barnes, W. H., *Can. J. Chem.*, 1956, **34,** 563.
3. — and —, *Ibid.*, 1961, **39,** 1739.

THE BAND SPECTRUM OF TITANIUM MONOIODIDE

A new band spectrum attributable to the diatomic molecule TiI has been excited in a quartz discharge tube containing a small quantity of heated titanium metal over which a regulated current of iodine vapour was kept flowing under low pressure conditions. The spectrum was also excited using argon as a carrier gas in a high frequency discharge from a 500 watt r.f. oscillator. In both these discharges, two characteristic band systems were observed and photographed in the first order of a 21′ concave grating spectrograph with a dispersion of 1·25 Å/mm. The system in the region λλ 4500–4430 Å is interpreted as the case c equivalent of the A $^4\Pi$–X $^4\Sigma$ system of TiCl and TiBr analysed recently by previous workers.[1-3] The other system in the region λλ 4050–4035 is suggested as the analogue of B $^4\Sigma$–X $^4\Sigma$ system of TiCl reported previously.[2] Details of the vibrational analysis of the two systems of TiI are given in Fig. 1.

The system reproduced in strips *a*, *b*, *c* of Fig. 1 consists of three groups of bands degraded to shorter wavelengths, the separation between adjacent groups being 150 cm.$^{-1}$ Since this spacing is too small to be interpreted as a vibrational interval for TiI, it is most plausible to assume that it corresponds to the separation between the components of a multiplet transition. Since for TiI, states of doublet and quartet multiplicities are expected, the three groups of bands can be interpreted as three component systems of a $^4\Pi$–$^4\Sigma$ transition, analogous to the A $^4\Pi$–X $^4\Sigma$ transition in TiCl and TiBr. As the multiplet splitting of the $^4\Pi$ state in TiI is of the order of 150 cm.$^{-1}$, we might expect a transition to Hunds case *c*, in the upper $^4\Pi$ state. In case *c*, the electron orbital angular momentum L, and the total spin S, combine to give resultant J_a, the components of which along the internuclear axis Ω, determine the nature of the state. If $J_a = 5/2$ which is one of the values resulting from $L = 1$, $S = 3/2$ three case *c* states result, namely, 5/2, 3/2 and 1/2 which should lie fairly close together and which to a first approximation should be equally spaced. It is suggested that such a triad of states constitutes the upper state of the present system of TiI, the lower state being $^4\Sigma$. In such a transition, three component systems are expected, each band consisting of a P, Q, R branch together with a number of weak branches. The three groups of bands shown in Fig. 1 are interpreted as the $\Delta v = 0$ sequences of the three component systems, with an approximate splitting of 150 cm.$^{-1}$ between the components. In each group, the Q heads are easily identified. In the case of a few bands, the P heads are also identified. The measurements and classification of the heads are shown in Table I. The differences in intensity of the three multiplet components should be noted. Such variations are not unusual in case *c* transitions. The separation between successive bands in each group is approximately 14 cm.$^{-1}$ and as the bands are shaded towards violet ω_e' is greater than ω_e'' by about 14 cm.$^{-1}$ No outside sequences $\Delta v = \pm 1$ are, in fact, observed, which can be reasonably attributed to the fact, that the B_e values and the r_e values are almost equal in the upper and lower states.

Table I

List of wavelengths and vacuum wave numbers of the system of TiI in the region λ 4500–λ 4430

λ	ν	I	Classification	
4499·02	22220·9	4	0, 0	Q
4495·74	22237·1	3	1, 1	Q
4493·05	22250·4	2	2, 2	Q
4489·72	22266·9	1	3, 3	Q
4468·01	22375·1	10	0, 0	P
4466·97	22380·3	10	0, 0	Q
4464·42	22393·1	9	1, 1	Q
4461·57	22407·4	9	2, 2	Q
4459·93	22415·6	4	3, 3	P
4458·68	22421·9	7	3, 3	Q
4455·87	22436·1	7	4, 4	Q
4439·45	22519·0	4	0, 0	P
4437·95	22526·6	10	0, 0	Q
4436·38	22534·6*	3	1, 1	P
4435·17	22540·7	9	1, 1	Q
4432·51	22554·3	7	2, 2	Q
4430·09	22566·6	5	3, 3	Q

* Superposed by atomic line.

In addition to the above system, the spectrum of TiI shows a single sequence of bands

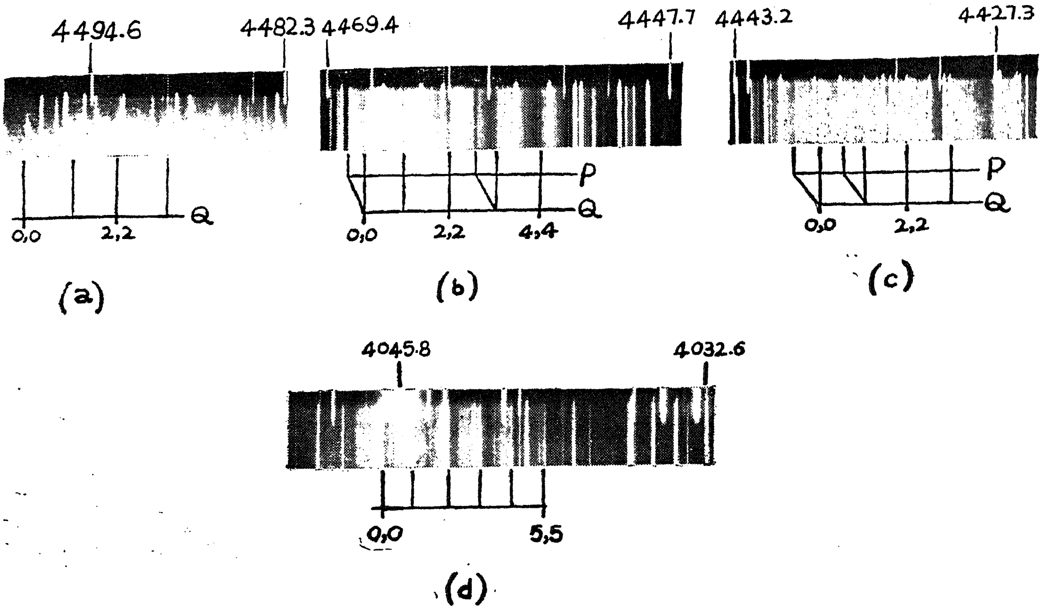


FIG. 1. *a*, *b*, *c*. The $\Delta v=0$ sequences of the three case *c* component systems of the $A\,^4\Pi - X\,^4\Sigma$ transition of TiI. *d*. The $\Delta v=0$ sequence of the $B\,^4\Sigma = X^4\Sigma$ system of TiI.

degraded to longer wavelengths in the region λλ 4050–4035 Å whose measurements and classifications are shown in Table II. The classifications of the bands are shown in strip *d* of

TABLE II

List of wavelengths and vacuum wave numbers of the system of TiI in the region λ 4050–λ 4035

λ	ν	I	Classification
4046·55	24705·4	10	0, 0
4045·27	24713·3	9	1, 1
4043·77	24722·4*	9	2, 2
4042·31	24731·4	5	3, 3
4040·94	24739·8	4	4, 4
4039·52	24748·4	3	5, 5

* Superposed by atomic line.

Fig. 1. A peculiar feature of this sequence is that while the bands are degraded to longer wavelengths, the vibrational structure is degraded towards shorter wavelengths. As the separation between successive bands is approximately 9 cm.$^{-1}$ the vibrational frequency in the upper state is greater than that of the lower state by about 9 K. As the bands are single-headed the system can be interpreted as $B\,^4\Sigma - X\,^4\Sigma$ of TiI analogous to that of $B\,^4\Sigma - X\,^4\Sigma$ system of TiCl at λ 3860 Å.

Two of the authors (Ch. Sivaji and D. V. K. Rao) are grateful to the C.S.I.R. (New Delhi) for the financial assistance.

Physics Department,
Andhra University,
Waltair (India),
November 26, 1969.

CH. SIVAJI.
D. V. K. RAO.
P. TIRUVENGANNA RAO.

---

1. Shenyavskaya, E. A., Kuzyakov, Yu. Ya. and Tatoskil, V. M., "Optics and spectroscopy", 1962, **12**, 197.
2. Chatalic, A., Deschamps, P. and Pannetier, G., *C. R. Acad. Sc. Paris*, *Series-C*, 1969, **268**, 1111.
3. Sivaji, Ch., and Rao, P. T., *J. Phys. B* (Atom and Molec.), In press (1970)

MINERALOGY OF ACHROITE (COLOURLESS TOURMALINE), FROM A PEGMATITE NEAR AJMER

THIS paper deals with the mineralogy of a rare occurrence of a colourless tourmaline (achroite) from a lithium pegmatite near the village Rajagarh, Ajmer District. The mineralogy comprises of the optical characters, X-ray, chemistry and trace element studies. The geological setting regarding its mode of occurrence and the probable origin is also dealt briefly.

Geological Setting.—Observations in the quarry reveal the country rocks to be contorted and highly metamorphosed schist and gneiss of archæan age. Megascopically, the rock appears to consist of a fine granular aggregate of quartz, biotite, garnet, intensely crushed. The banding in the gneiss is due to alignment of biotite flakes. Microscopically, the country rock consists of an irregular mosaic of quartz, plagioclase and biotite.

Field and megascopic study reveal three stages of mineralization. Before folding, the gneiss was invaded by solutions which resulted in the development of numerous lit-par-lit injections of quartz-felspar pegmatite with black tourmaline. In numerous instances, the felspar individual or the pegmatite are granulated or drawn out into augen shapes. After this lit-par-lit injection, there were two periods of pegmatite formation. These two stages of pegmatites are characterized by lithium and tourmaline mineralization. The second stage is exclusively dominated by tourmaline, beryl and apatite mineralization; while the third stage is characterised by lithium mineralization. The mineral "achroite" occurs along with blue, green and brown variety of tourmaline (Fig. 1).

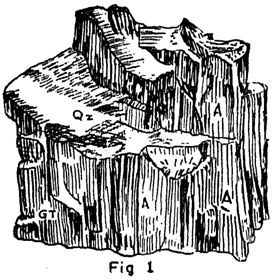


Fig 1

A = Colourless Tourmaline

GT = Green Tourmaline

Qz = Quartz

This colourless tourmaline (achroite) was separated from its associated tourmalines by using heavy liquids, for detailed optical, X-ray, chemical and trace element studies.

Mineralogy.—The tourmaline occurs as prismatic laths intergrown with pale brown and green tourmaline. It is also found sporadically along with rubelite of the third stage of pegmatite. Megascopically it is pale whitish-grey but colourless in thin section. It can be easily mistaken for topaz under microscope, owing to the lack of pleochroism. But its uniaxial negative character under conoscopic condition distinguishes it from topaz. Its optical characters are:

Refractive Indices :
by Immersion Method =
$\omega = 1{\cdot}640$
$\epsilon = 1{\cdot}621$
Birefringence $(\omega - \epsilon) = 0{\cdot}019$–$0{\cdot}020$
Optical Sign : Uniaxial Negative
Specific Gravity $= 3{\cdot}110$

The optical characters compare well with the optical characters mentioned by Hambürger and Büerger[1] for a colourless tourmaline from De Kalb, New York. There is also fair agreement for the range of refractive indices and specific gravity given by Deer *et al.*[2] for elabites.

X-ray Study.—Powdered X-ray diffraction pattern was taken for the mineral using CuK$_\alpha$ radiation with a nickel filter. The sample was scanned from 5°–60° at the rate of ½°/minute. The '*d*' spacings computed from the diffractograph agree well with the three prominent peaks listed in "ASTM" card for a colourless tourmaline, though there is a variation in the intensity.

The cell dimensions calculated from the '*d*' spacings agree closely with the cell dimensions listed for a colourless tourmaline.[1] The '*d*' spacings for the three major peaks together with the values cited in literature for a colourless tourmaline are presented in Table I.

TABLE I

Achroite from Rajagarh		Colourless tourmaline cited in "ASTM" card	
'*d*' values	I/I	'*d*' values	I/I
2·55	100	2·58	100
2·90	75	2·98	90
4·20	63	4·24	70

Chemistry.—As far as possible pure material from the mineral was taken by using a micro-drill and the material was treated with bromoform to remove salic minerals. The purity of the sample was tested under a binocular microscope before subjecting it to chemical analysis. Since the material was scanty, silica, alumina, and iron were determined by rapid methods of silicate analysis suggested by Schapiro and Brannock[3]; soda, potash, lithia and rubidium by Flame photometer; calcium, megnesium, manganese by Atomic absorption Perkin Elmer spectrometer; boron by gravimetry, and fluorine by volumetry. The analysis compares very well with the analysis of a colourless tourmaline reported by Dana[4] from "Auburn A" in his system of mineralogy (P. 555, Ana. 38), but for the slightly lower alumina, higher soda and manganese. The chemical analysis together with the number of ions calculated on the basis of 31(O, OH, F) along with the valency check is presented in Table II.

Trace Elements Study.—A small quantity of the mineral powder used for chemical analysis was subjected to emission spectrum analysis to study the nature of trace elements present in

TABLE II

Chemical analysis						Trace elements analysis	
A					B	A	
istituents	Wt. %	No. of ions on the basis of 31 (O, OH, F)		Valency check	Analysis for comparison	Elements	PPM
				Cations			
$)_2$	39·25	Si = 6·263	=15·366	Si^4 =25·052	SiO_2 = 38·14	Co	100
$)_2$	0·02	Ti = ..		B^3 = 9·309	TiO_2 = 0·00	Be	20
$)_3$	11·28	B = 3·103		Al^3 =20·166	B_2O_3 = 10·25	Sb	100
O_3	36·13	Al = 6·000		Fe^3 = 0·067	Al_2O_3 = 39·60	Pb	500
O_3	0·20	Al = 0·722	= 2·875	Fe^2 = 0·326	Fe_2O_3 = 0·30	Cr	100
)	1·23	Fe^3 = 0·019		Mn^2 = 0·516	FeO = 1·38	Sn	100
O	1·93	Fe^2 = 0·163		Mg^2 = 0·010	MnO = 1·38	Ni	500
O	0·02	Mn = 0·258		Ca^2 = 0·076	MgO = 0·00	Li	100
)	0·17	Mg = 0·009		Na^1 = 1·053	CaO = 0·43	V	100
$_2O$	3·36	Ca = 0·038		K^1 = 0·096	Na_2O = 2·36	Ti	200
)	0·53	Na = 1·053		Li^1 = 0·517	K_2O = 0·27	Zn	500
$_2O$	0·05	K = 0·096			Li_2O = 1·34	Cu	50
O	0·77	Li = 0·517		57·186	H_2O = 4·16	Ag	50
)	4·22	OH = 4·462	= 4·807		F = 0·62	Sc	50
	0·68	F = 0·345					
	99·84				100·23		
				Anions			
				OH^1 = 4·462			
s O F	= 0·34	O =26·193		F^1 = 0·345	Less O = 0·31 for F		
				O^2 =52·386			
	99·50			57·193	99·92		

A—Achroite from Rajgarh. Analyst: S. K. Babu

B—Colourless tourmaline, Auburn A quoted by Dana on page 555, Anal. No. 38 in his *System of Mineralogy*

mineral. The trace elements present in the neral are Co, Be, Sb, Pb, Sn, Ni, Bi, V, Ti, , Ag, Zn. The type and distribution of trace ments are fairly in agreement with those ported for colourless tourmaline by Carobbi d Pieraccini[5] (P. 124, Anas. 19, 20). The ce elements data are presented in Table II ppm level. The presence of Cu, Bi, Sn, Be, V, Pb points to the dominant role of eumatolytic alkali and alkaline metal vapours ring the formation of pegmatite, and the eumatolytic igneous origin of the mineral. The author records his sincere thanks to ssrs. Jakal, L. C. Chandola and K. T. seph of Bhabha Atomic Research Centre for ir help in X-ray, Spectrographic and Atomic sorption studies and to the Heads of the visions, B.A.R.C., for affording facilities to rk in their laboratories.

pt. of Applied Geology, S. K. BABU.
iversity of Saugar,
gar (M.P.), *November* 11, 1969.

Hambürger, G. E. and Büerger, M. T., *Am. Miner.*, 1948, **33**, 531.

Deer, W. A. Howie, R. A. and Zusman, J., *Rock Forming Minerals*, Longmans, Green and Co. Ltd 1965, **1**, 300.

3. Schapiro, L. and Brunnock, W. W., *Bull. U.S. Geol. Surv.*, 1960, No. 1144-A.
4. Dana, E. S., *A System of Mineralogy*, John Wiley and Sons, New York, 1904, p. 555.
5. Carrobbi, G. and Pieruccini, R., *Am. Miner.*, 1947, **32**, 121.

DIFFERENTIAL THERMAL ANALYSIS (D.T.A.) STUDY OF SOME CARBONATE ROCKS OF THE KROL SERIES

NINETEEN samples of the carbonate rocks of the Krol Series from Sahasradhara (30° 23′ 10″ 78° 07′ 30″) and Banghat near Satpuli (29° 58′ 87° 48′ 50″) stratigraphic sections were subjected to differential thermal analysis (D.T.A. using conventional equipment consisting of a high temperature alloy furnace, quartz sample tubes, sample holders, platinum thermocouples, amperage regulator, galvanometer and photographic paper recording. Calcined alumina was used as the internal standard against which the thermograms of the samples were recorded. A standard calibration curve was prepared from the thermograms of sodium sulphate and potassium sulphate which yield characteristic endothermic peaks at 100° C., 240° C., 585° C., 884° C. and 1,064° C. for purposes of reading the sample thermograms.

TABLE I

Differential thermal analysis (endothermic) data on some carbonate rocks of the Krol Series (temperatures on Centrigrade scale)

Stratigraphic section	Formation	Sample No.	Magnesite	Calcite	Dolomite	
					Lower peak	Higher peak
Sahasradhara	Krol E	s 97	..	..	820	920
		s 98	..	..	805	835
	Krol D	s 99	..	..	820	940
		s 102	685	..	..	..
		s 104	..	950	..	..
		s 105	..	..	820	950
		s 108	700	..	780	930
		s 109	..	..	800	930
		s 110	640	..	810	940
	Krol C	s 113	..	..	820	920
Banghat	Krol D	s 47	..	..	800	930
		s 49	..	..	805	935
		s 51	..	..	810	930
		s 53	..	..	825	940
		s 54	..	..	830	940
	Krol C	s 57	..	..	825	935
		s 58	..	950	..	..
		s 60	..	..	810	935
	Krol A	s 63	..	..	820	930

Table I presents the results of differential thermal analysis of the carbonate rocks of the Krol series under study. Sahasradhara section incorporates ten samples (two of Krol E, seven of Krol D, and one of Krol C) and Banghat section nine samples (five of Krol D, three of Krol C and one of Krol A). The sample numbers in Table I are arranged according to their stratigraphic order of occurrence. Sahasradhara section represents the southern limb, Banghat section, the northern limb of Krol syncline. An inspection of Table I reveals that in Sahasradhara section, the two samples of Krol E show the double endothermic peak for dolomite. Therefore, the samples are dolomites. In Krol D formation, sample No. 104 shows a single endothermic peak for calcite at 950° C.; therefore, the rock is a pure limestone (calcite rich phase). Sample No. 102 exhibits an endothermic peak at 685° C. This corresponds to magnesite and hence the sample is identified as magnesite. Sample Nos. 108 and 110 show, besides the double endothermic peak for dolomite, two peaks at a lower temperature 700° C. and 640° C. respectively. This suggests that these two samples incorporate in addition to dolomite, a magnesite phase. The rest of the Krol D samples are dolomites. The Krol C sample (S. 113) is also a dolomite. In rocks of Banghat section, all the samples of Krol D formation are dolomites. In Krol C formation, two samples are dolomites and the only sample S. 58 is a limestone with the solitary calcite endothermic peak at 950° C.

Krol A and C formations are generally regarded as limestone units based on field characters (Ranga Rao and Murthy, 1960). The results of the present study reveal that many samples of Krol C and A units are more dolomites than limestones. This would indicate that in any investigation of carbonate rocks, both at the outcrop and subsurface levels, a combination of field and laboratory study is essential especially when petroleum exploration is involved.

A pure dolomite shows a double endothermic peak, the lower between 700-770° C. and the higher 900-930° C. (Teodorovich, 1961). In the samples under study, while the higher peaks are consistently about the limits of a pure dolomite, the lower peaks are consistently above 770° C. This may be due to particle size variation, variable resistance, and more than all to iron and manganese structural impurities in the dolomites under study.

Occurrence of pure magnesite and magnesite associated dolomites in the samples of Sahasradhara section is of some importance. Valadiya (1968) has shown that the magnesite deposits in the calc zone of Pithoragarh, Kumaun Himalayas, U.P., are a back reef lagoonal or bay facies of a stromatolite biotherm. If this is true, the magnesite deposits represent members of a back reef evaporate sequence. Occurrence of magnesite rocks and magnesite bearing dolomites in the rocks of Sahasradhara section, further supports the earlier conclusion (Rao, 1964) that the Krols represent a phase in the development of an evaporate sequence.

The present work was accomplished in the Institute of Geology and Exploration of Combustible and Fuel Rocks (EGERGE), Academy of Sciences, U.S.S.R., during the tenure of an U.N.D.P. short-term fellowship in 1967 for the study of Sedimentary Mineralogy. The writer is thankful to the U.N.D.P. authorities for the award of a fellowship, to Professor G. I. Teodorovich for guidance in the work, and to Mrs. A. M. Kassianova for help in laboratory analysis.

Inst. of Petroleum Exploration,
O.N.G. Commission, Kaulagarh Road,
Dehra Dun, *October* 23, 1969.

C. GUNDU RAO.

TABLE II

Chemical analysis						Trace elements analysis	
A					B	A	
Constituents	Wt. %	No. of ions on the basis of 31 (O, OH, F)		Valency check	Analysis for comparison	Elements	PPM
				Cations			
SiO_2	39·25	Si = 6·263		Si^4 =25·052	SiO_2 = 38·14	Co	100
TiO_2	0·02	Ti = ..	=15·366	B^3 = 9·309	TiO_2 = 0·00	Be	50
B_2O_3	11·28	B = 3·103		Al^3 =20·166	B_2O_3 = 10·25	Sb	100
Al_2O_3	36·13	Al = 6·000		Fe^3 = 0·067	Al_2O_3 = 39·60	Pb	500
Fe_2O_3	0·20	Al = 0·722		Fe^2 = 0·326	Fe_2O_3 = 0·30	Cr	100
FeO	1·23	Fe^3 = 0·019		Mn^2 = 0·516	FeO = 1·38	Sn	100
MnO	1·93	Fe^2 = 0·163		Mg^2 = 0·010	MnO = 1·38	Ni	500
MgO	0·02	Mn = 0·258		Ca^2 = 0·076	MgO = 0·00	Li	100
CaO	0·17	Mg = 0·009	= 2·875	Na^1 = 1·053	CaO = 0·43	V	100
Na_2O	3·36	Ca = 0·038		K^1 = 0·096	Na_2O = 2·36	Ti	200
K_2O	0·53	Na = 1·053		Li^1 = 0·517	K_2O = 0·27	Zn	500
Rb_2O	0·05	K = 0·096			Li_2O = 1·34	Cu	50
Li_2O	0·77	Li = 0·517		57·186	H_2O = 4·16	Ag	50
H_2O	4·22	OH = 4·462	= 4·807		F = 0·62	Sc	50
F	0·68	F = 0·345					
	99·84				100·23		
				Anions			
				OH^1 = 4·462			
Less O for F	= 0·34	O =26·193		F^1 = 0·345	Less O for F = 0·31		
				O^2 =52·386			
	99·50			57·193	99·92		

A—Achroite from Rajagarh, Analyst: S. K. Babu
B—Colourless tourmaline, Auburn A quoted by Dana on page 555, Anal. No. 38 in his *System of Mineralogy*

the mineral. The trace elements present in the mineral are Co, Be, Sb, Pb, Sn, Ni, Bi, V, Ti, Cu, Ag, Zn. The type and distribution of trace elements are fairly in agreement with those reported for colourless tourmaline by Carobbi and Pieraccini[5] (P. 124, Anas. 19, 20). The trace elements data are presented in Table II at ppm level. The presence of Cu, Bi, Sn, Be, Ni, V, Pb points to the dominant role of pneumatolytic alkali and alkaline metal vapours during the formation of pegmatite, and the pneumatolytic igneous origin of the mineral.

The author records his sincere thanks to Messrs. Jakal, L. C. Chandola and K. T. Joseph of Bhabha Atomic Research Centre for their help in X-ray, Spectrographic and Atomic absorption studies and to the Heads of the Divisions, B.A.R.C., for affording facilities to work in their laboratories.

Dept. of Applied Geology, S. K. BABU.
University of Saugar,
Sagar (M.P.), *November* 11, 1969.

---

1. Hambürger, G. E. and Büerger, M. T., *Am. Miner.*, 1948, **33**, 531.
2. Deer, W. A. Howie, R. A. and Zusman, J., *Rock Forming Minerals*, Longmans, Green and Co. Ltd 1965, **1**, 300.
3. Schapiro, L. and Brunnock, W. W., *Bull. U.S. Geol. Surv.*, 1960, No. 1144-A.
4. Dana, E. S., *A System of Mineralogy*, John Wiley and Sons, New York, 1904, p. 555.
5. Carrobbi, G. and Pieruccini, R., *Am. Miner.*, 1947, **32,** 121.

DIFFERENTIAL THERMAL ANALYSIS (D.T.A.) STUDY OF SOME CARBONATE ROCKS OF THE KROL SERIES

NINETEEN samples of the carbonate rocks of the Krol Series from Sahasradhara (30° 23′ 10″ : 78° 07′ 30″) and Banghat near Satpuli (29° 58′ : 87° 48′ 50″) stratigraphic sections were subjected to differential thermal analysis (D.T.A.) using conventional equipment consisting of a high temperature alloy furnace, quartz sample tubes, sample holders, platinum thermocouples, amperage regulator, galvanometer and photographic paper recording. Calcined alumina was used as the internal standard against which the thermograms of the samples were recorded. A standard calibration curve was prepared from the thermograms of sodium sulphate and potassium sulphate which yield characteristic endothermic peaks at 100° C., 240° C., 585° C., 884° C. and 1,064° C. for purposes of reading the sample thermograms.

Table I [illegible]

Table I

Differential [illegible] analysis [illegible]

[illegible]

Stratigraphic section	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chakrata	Krol E	96	..	..	[illegible]	[illegible]
		98	..	..	[illegible]	[illegible]
	Krol D	S 99	..	..	[illegible]	940
		102	685	..	..	..
		S 104	..	[illegible]	..	..
		S 106	..	..	840	940
		S 108	760	..	790	950
		S 109	..	..	800	950
		S 110	640	..	840	940
	Krol C	[illegible]	..	..	[illegible]	[illegible]
Langhat	Krol D	4	..	..	800	930
		[illegible]	..	..	[illegible]	[illegible]
		51	..	..	810	[illegible]
		[illegible]	..	..	[illegible]	940
		[illegible]	..	..	[illegible]	[illegible]
	Krol C	[illegible]	..	..	[illegible]	[illegible]
		[illegible]	..	940	..	..
		[illegible]	..	..	810	935
	Krol B	[illegible]	..	..	[illegible]	[illegible]

Thermal analysis of the carbonate rocks of the Krol [illegible] incorporates ten samples of [illegible] Krol E, [illegible] of Krol D, and [illegible] of Krol C and Krol B [illegible] section nine samples [illegible] of Krol D [illegible] of Krol C and [illegible] of Krol B. The samples numbers in Table I are arranged according to their stratigraphic order of succession. Chakrata section represents the [illegible] Langhat section the northern [illegible] of Krol outcrops. An inspection of Table I reveals that in Chakrata section, the two samples of Krol E show the double endothermic peak for dolomite. Therefore the samples are dolomites. In Krol D formation, sample No. 104 has a single endothermic peak for calcite at [illegible] C, therefore, the rock is a pure limestone (calcite rich phase). Sample No. 102 exhibits an endothermic peak at 685 C. This corresponds to magnesite and hence the sample is identified as magnesite. Sample Nos. 108 and 110 show, besides the double endothermic peak for dolomite, two peaks at a lower temperature 760 C and 640 C respectively. This suggests that these two samples incorporate in addition to dolomite, a magnesite phase. The rest of the Krol D samples are dolomites. The Krol C sample (S 113) is also a dolomite. In rocks [illegible] as well as the samples of Krol D [illegible] dolomite. In Krol C formation [illegible] dolomite [illegible] the only [illegible] with the solitary cal[illegible] at [illegible] C.

[illegible] Krol C formation are [illegible] based on field [illegible] Murty, 1966). The [illegible] Krol C and [illegible] are more dolo[illegible]. This would indicate that [illegible] of carbonate rocks both [illegible] level, a [illegible] laboratory study is [illegible] petroleum explora[illegible]

[illegible] double endothermic [illegible] between 700 [illegible] C and the [illegible] C (Ivanova et al., 1961). In the [illegible] which the lower peak [illegible] about the [illegible] of a pure [illegible] lower peak are consistently [illegible] C. This may be due to particle [illegible] and more [illegible] structural [illegible] dolomite under study.

The presence of [illegible] magnesite and magne[illegible] dolomites in the samples of [illegible] of some importance [illegible] (1966) has shown that the magnesite [illegible] of Pithoragarh Kumaun [illegible] lagoonal or [illegible] conditions. It the [illegible] the magnesite deposit [illegible] evaporite sequence. [illegible] magnesite rocks and magnesite bear[illegible] in the [illegible] of Chakrata section further supports the earlier conclusion ([illegible] 1966) that the Krol represent a phase in the development of an evaporite sequence.

The present work was accomplished in the [illegible] of Geology and Exploration of Com[illegible] and Fuel Rocks (IGERGI), Academy of Sciences, USSR during the tenure of an UNDP short term fellowship in 1967 for the study of Sedimentary Mineralogy. The writer is thankful to the UNDP authorities for the award of fellowship, to Professor G. I. Teodorovich for guidance in the work and to Mrs. A. M. Karsanova for help in laboratory analyses.

Inst. of Petroleum C. Gnane Rao
Exploration,
O.N.G. Commission, Kaulagarh Road,
Dehra Dun, *October* 23, 1969.

TABLE II

Chemical analysis						Trace elements analysis	
A					B	A	
Constituents	Wt. %	No. of ions on the basis of 31 (O, OH, F)		Valency check	Analysis for comparison	Elements	PPM
				Cations			
SiO_2	39·25	Si = 6·263		Si^4 = 25·052	SiO_2 = 38·14	Co	<100
TiO_2	0·02	Ti = ..	= 15·366	B^3 = 9·309	TiO_2 = 0·00	Be	<50
B_2O_3	11·28	B = 3·103		Al^3 = 20·166	B_2O_3 = 10·25	Sb	<100
Al_2O_3	36·13	Al = 6·000		Fe^3 = 0·067	Al_2O_3 = 39·60	Pb	500
Fe_2O_3	0·20	Al = 0·722		Fe^2 = 0·326	Fe_2O_3 = 0·30	Cr	<100
FeO	1·23	Fe^3 = 0·019		Mn^2 = 0·516	FeO = 1·38	Sn	100
MnO	1·93	Fe^2 = 0·163		Mg^2 = 0·010	MnO = 1·38	Ni	500
MgO	0·02	Mn = 0·258		Ca^2 = 0·076	MgO = 0·00	Li	100
CaO	0·17	Mg = 0·009	= 2·875	Na^1 = 1·053	CaO = 0·43	V	<100
Na_2O	3·36	Ca = 0·038		K^1 = 0·096	Na_2O = 2·36	Ti	200
K_2O	0·53	Na = 1·053		Li^1 = 0·517	K_2O = 0·27	Zn	<500
Rb_2O	0·05	K = 0·096			Li_2O = 1·34	Cu	50
Li_2O	0·77	Li = 0·517		57·186	H_2O = 4·16	Ag	50
H_2O	4·22	OH = 4·462	= 4·807		F = 0·62	Sc	50
F	0·68	F = 0·345					
					100·23		
	99·84			Anions			
				OH^1 = 4·462			
Less O for F	= 0·34	O = 26·193		F^1 = 0·345	Less O for F = 0·31		
				O^2 = 52·386			
	99·50			57·193	99·92		

A—Achroite from Rajagarh, Analyst: S. K. Babu

B—Colourless tourmaline, Auburn A quoted by Dana on page 555, Anal. No. 38 in his *System of Mineralogy*

the mineral. The trace elements present in the mineral are Co, Be, Sb, Pb, Sn, Ni, Bi, V, Ti, Cu, Ag, Zn. The type and distribution of trace elements are fairly in agreement with those reported for colourless tourmaline by Carobbi and Pieraccini[5] (P. 124, Anas. 19, 20). The trace elements data are presented in Table II at ppm level. The presence of Cu, Bi, Sn, Be, Ni, V, Pb points to the dominant role of pneumatolytic alkali and alkaline metal vapours during the formation of pegmatite, and the pneumatolytic igneous origin of the mineral.

The author records his sincere thanks to Messrs. Jakal, L. C. Chandola and K. T. Joseph of Bhabha Atomic Research Centre for their help in X-ray, Spectrographic and Atomic absorption studies and to the Heads of the Divisions, B.A.R.C., for affording facilities to work in their laboratories.

Dept. of Applied Geology, S. K. BABU.
University of Saugar,
Sagar (M.P.), *November* 11, 1969.

---

1. Hambürger, G. E. and Büerger, M. T., *Am. Miner.*, 1948, **33**, 531.
2. Deer, W. A. Howie, R. A. and Zusman, J., *Rock Forming Minerals*, Longmans, Green and Co. Ltd 1965, **1**, 300.
3. Schapiro, L. and Brunnock, W. W., *Bull. U.S. Geol. Surv.*, 1960, No. 1144-A.
4. Dana, E. S., *A System of Mineralogy*, John Wiley and Sons, New York, 1904, p. 555.
5. Carrobbi, G. and Pieruccini, R., *Am. Miner.*, 1947, **32**, 121.

DIFFERENTIAL THERMAL ANALYSIS (D.T.A.) STUDY OF SOME CARBONATE ROCKS OF THE KROL SERIES

NINETEEN samples of the carbonate rocks of the Krol Series from Sahasradhara (30° 23′ 10″ : 78° 07′ 30″) and Banghat near Satpuli (29° 58′ : 87° 48′ 50″) stratigraphic sections were subjected to differential thermal analysis (D.T.A.) using conventional equipment consisting of a high temperature alloy furnace, quartz sample tubes, sample holders, platinum thermocouples, amperage regulator, galvanometer and photographic paper recording. Calcined alumina was used as the internal standard against which the thermograms of the samples were recorded. A standard calibration curve was prepared from the thermograms of sodium sulphate and potassium sulphate which yield characteristic endothermic peaks at 100° C., 240° C., 585° C., 884° C. and 1,064° C. for purposes of reading the sample thermograms.

Table I [illegible]

Table I

D.T.A. [illegible] [illegible]

Stratigraphic section	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chharradhata	Krol E	96	..		[illegible]	[illegible]
		98	..	..	[illegible]	[illegible]
	Krol D	S 99	..		[illegible]	940
		102	6[illegible]0	..	..	..
		S 104	..	950	..	..
		S 105	..	..	810	[illegible]
		S 108	700	..	750	930
		S 109	..		800	930
		S 110	640	..	830	920
	Krol C	S 113	..	..	820	930
Barghat	Krol D	4[illegible]	..	..	800	930
		47	..	..	810	920
		51	..		810	920
		S 54	..	..	820	940
		74	..		830	940
	Krol C	[illegible]	..	..	820	930
		58	..	950	..	..
		62	..	..	800	935
	Krol B	[illegible]	..		820	930

thermal analysis of the carbonate rocks of the Krol series shows that Chharradhata section incorporates [illegible] samples of Krol E, [illegible] of Krol D, and one of Krol C, and Barghat section has samples [illegible] of Krol D, [illegible] of Krol C and one of Krol B. The sample numbers in Table I are arranged according to the stratigraphic order of occurrence. Chharradhata section represents the southern [illegible] Barghat section, the northern [illegible] of Krol [illegible]. An inspection of Table I reveals that in Chharradhata section, the two samples of Krol E show the double endothermic peak for dolomite. Therefore, the samples are dolomites. In Krol D formation, sample No. 104 shows a single endothermic peak for calcite at 950° C, therefore, the rock is a pure limestone (calcite rich phase). Sample No. 102 exhibits an endothermic peak at 680° C. This corresponds to magnesite and hence the sample is identified as magnesite. Sample Nos. 108 and 110 show, besides the double endothermic peak for dolomite, two peaks at a lower temperature 700° C and 640° C respectively. This suggests that these two samples incorporate in addition to dolomite, a magnesite phase. The rest of the Krol D samples are dolomites. The Krol C sample (S 113) is also a dolomite. In Barghat section, all the samples of Krol D [illegible] dolomite. In Krol C formation, [illegible] dolomite, and the only calcite [illegible] limestone with the solitary calcite peak at 950° C.

[illegible] Krol C formation are generally regarded as [illegible] unit based on field characters [illegible] (Rao and Murthy, 1960). The [illegible] revealed that many [illegible] Krol C and A that are more dolomitic [illegible]. This would indicate that [illegible] of carbonate rocks both [illegible] level, a combined field and laboratory study is [illegible] when petroleum exploration [illegible].

[illegible] dolomite shows a double endothermic [illegible] between 800-830° C and the [illegible] 920-950° C (Ivanova, 1961). In the [illegible] while the higher peak [illegible] about the limit of a pure [illegible] lower peaks are consistently [illegible] C. This may be due to particle [illegible] and more [illegible] structural [illegible] dolomite under study.

Occurrence of pure magnesite and magnesite-bearing dolomites in the samples of [illegible] some important [illegible] has shown that the magnesite [illegible] zone of Pithoragarh, Kumaun [illegible] U.P. [illegible] geosynclinal [illegible]. If the [illegible] magnesite deposits represent [illegible] evaporite sequence. Occurrence of magnesite rock and magnesite bearing [illegible] in the rocks of Chharradhata [illegible] further supports the earlier conclusion (Rao, 1964) that the Krols represent a phase [illegible] development of an evaporite sequence.

The present work was accomplished in the [illegible] of Geology and Exploration of Combustible and Fuel Rock (IGERGI), Academy of Sciences, U.S.S.R., during the tenure of an U.N.D.P. short term fellowship in 1967 for the study of Sedimentary Mineralogy. The writer is thankful to the U.N.D.P. authorities for the award of fellowship, to Professor G. I. Teodorovich for guidance in the work, and to Mrs. A. M. Karasanova for help in laboratory analyses.

Inst. of Petroleum
Exploration,
O.N.G. Commission, Kaulagarh Road,
Dehra Dun, *October* 23, 1969.

C. Gundu Rao.

TABLE II

Chemical analysis						Trace elements analysis	
A					B	A	
Constituents	Wt. %	No. of ions on the basis of 31 (O, OH, F)		Valency check	Analysis for comparison	Elements	PPM
				Cations			
SiO_2	39·25	Si = 6·263	= 15·366	Si^4 = 25·052	SiO_2 = 38·14	Co	<100
TiO_2	0·02	Ti = ..		B^3 = 9·309	TiO_2 = 0·00	Be	< 50
B_2O_3	11·28	B = 3·103		Al^3 = 20·166	B_2O_3 = 10·25	Sb	<100
Al_2O_3	36·13	Al = 6·000		Fe^3 = 0·067	Al_2O_3 = 39·60	Pb	500
Fe_2O_3	0·20	Al = 0·722	= 2·875	Fe^2 = 0·326	Fe_2O_3 = 0·30	Cr	<100
FeO	1·23	Fe^3 = 0·019		Mn^2 = 0·516	FeO = 1·38	Sn	100
MnO	1·93	Fe^2 = 0·163		Mg^2 = 0·010	MnO = 1·38	Ni	500
MgO	0·02	Mn = 0·258		Ca^2 = 0·076	MgO = 0·00	Bi	100
CaO	0·17	Mg = 0·009		Na^1 = 1·053	CaO = 0·43	V	<100
Na_2O	3·36	Ca = 0·038		K^1 = 0·096	Na_2O = 2·36	Ti	200
K_2O	0·53	Na = 1·053		Li^1 = 0·517	K_2O = 0·27	Zn	<500
Rb_2O	0·05	K = 0·096			Li_2O = 1·34	Cu	50
Li_2O	0·77	Li = 0·517		57·186	H_2O = 4·16	Ag	50
H_2O	4·22	OH = 4·462	= 4·807		F = 0·62	Sc	50
F	0·68	F = 0·345					
					100·23		
	99·84			Anions			
				OH^1 = 4·462			
Less O for F	= 0·34	O = 26·193		F^1 = 0·345	Less O for F = 0·31		
				O^2 = 52·386			
	99·50			57·193	99·92		

A—Achroite from Rajagarh, Analyst: S. K. Babu

B—Colourless tourmaline, Auburn A quoted by Dana on page 555, Anal. No. 38 in his *System of Mineralogy*

the mineral. The trace elements present in the mineral are Co, Be, Sb, Pb, Sn, Ni, Bi, V, Ti, Cu, Ag, Zn. The type and distribution of trace elements are fairly in agreement with those reported for colourless tourmaline by Carobbi and Pieraccini[5] (P. 124, Anas. 19, 20). The trace elements data are presented in Table II at ppm level. The presence of Cu, Bi, Sn, Be, Ni, V, Pb points to the dominant role of pneumatolytic alkali and alkaline metal vapours during the formation of pegmatite, and the pneumatolytic igneous origin of the mineral.

The author records his sincere thanks to Messrs. Jakal, L. C. Chandola and K. T. Joseph of Bhabha Atomic Research Centre for their help in X-ray, Spectrographic and Atomic absorption studies and to the Heads of the Divisions, B.A.R.C., for affording facilities to work in their laboratories.

Dept. of Applied Geology, S. K. BABU.
University of Saugar,
Sagar (M.P.), *November* 11, 1969.

---

1. Hambürger, G. E. and Büerger, M. T., *Am. Miner.*, 1948, **33**, 531.
2. Deer, W. A. Howie, R. A. and Zusman, J., *Rock Forming Minerals*, Longmans, Green and Co. Ltd 1965, **1**, 300.
3. Schapiro, L. and Brunnock, W. W., *Bull. U.S. Geol. Surv.*, 1960, No. 1144-A.
4. Dana, E. S., *A System of Mineralogy*, John Wiley and Sons, New York, 1904, p. 555.
5. Carrobbi, G. and Pieruccini, R., *Am. Miner.*, 1947, **32**, 121.

DIFFERENTIAL THERMAL ANALYSIS (D.T.A.) STUDY OF SOME CARBONATE ROCKS OF THE KROL SERIES

NINETEEN samples of the carbonate rocks of the Krol Series from Sahasradhara (30° 23′ 10″ : 78° 07′ 30″) and Banghat near Satpuli (29° 58′ : 87° 48′ 50″) stratigraphic sections were subjected to differential thermal analysis (D.T.A.) using conventional equipment consisting of a high temperature alloy furnace, quartz sample tubes, sample holders, platinum thermocouples, amperage regulator, galvanometer and photographic paper recording. Calcined alumina was used as the internal standard against which the thermograms of the samples were recorded. A standard calibration curve was prepared from the thermograms of sodium sulphate and potassium sulphate which yield characteristic endothermic peaks at 100° C., 240° C., 585° C., 884° C. and 1,064° C. for purposes of reading the sample thermograms.

Table I presents the results of differential thermal analysis of the carbonate rocks of the Krol series under study. Sahasradhara section incorporates ten samples (two of Krol E, seven of Krol D, and one of Krol C) and Banghat section nine samples (five of Krol D, three of Krol C and one of Krol A). The sample numbers in Table I are arranged according to their stratigraphic order of occurrence. Sahasradhara section represents the southern limb, Banghat section, the northern limb of Krol syncline. An inspection of Table I reveals that in Sahasradhara section, the two samples of Krol E show the double endothermic peak for dolomite. Therefore, the samples are dolomites. In Krol D formation, sample No. 104 shows a single endothermic peak for calcite at 950° C.; therefore, the rock is a pure limestone (calcite rich phase). Sample No. 102 exhibits an endothermic peak at 685° C. This corresponds to magnesite and hence the sample is identified as magnesite. Sample Nos. 108 and 110 show, besides the double endothermic peak for dolomite, two peaks at a lower temperature 700° C. and 640° C. respectively. This suggests that these two samples incorporate in addition to dolomite, a magnesite phase. The rest of the Krol D samples are dolomites. The Krol C sample (S. 113) is also a dolomite. In rocks of Banghat section, all the samples of Krol D formation are dolomites. In Krol C formation, two samples are dolomites and the only sample S. 58 is a limestone with the solitary calcite endothermic peak at 950° C.

TABLE I

Differential thermal analysis (endothermic) data on some carbonate rocks of the Krol Series (temperatures on Centrigrade scale)

Stratigraphic section	Formation	Sample No.	Magnesite	Calcite	Dolomite Lower peak	Dolomite Higher peak
Sahasradhara	Krol E	s 97	..	..	820	920
		s 98	..	..	805	835
	Krol D	s 99	..	..	820	940
		s 102	685	..	..	..
		s 104	..	950	..	..
		s 105	..	..	820	950
		s 108	700	..	780	930
		s 109	..	..	800	930
		s 110	640	..	810	940
	Krol C	s 113	..	..	820	920
Banghat	Krol D	s 47	..	..	800	930
		s 49	..	..	805	935
		s 51	..	..	810	930
		s 53	..	..	825	940
		s 54	..	..	830	940
	Krol C	s 57	..	..	825	935
		s 58	..	950	..	..
		s 60	..	..	810	935
	Krol A	s 63	..	..	820	930

Krol A and C formations are generally regarded as limestone units based on field characters (Ranga Rao and Murthy, 1960). The results of the present study reveal that many samples of Krol C and A units are more dolomites than limestones. This would indicate that in any investigation of carbonate rocks, both at the outcrop and subsurface levels, a combination of field and laboratory study is essential especially when petroleum exploration is involved.

A pure dolomite shows a double endothermic peak, the lower between 700-770° C. and the higher 900-930° C. (Teodorovich, 1961). In the samples under study, while the higher peaks are consistently about the limits of a pure dolomite, the lower peaks are consistently above 770° C. This may be due to particle size variation, variable resistance, and more than all to iron and manganese structural impurities in the dolomites under study.

Occurrence of pure magnesite and magnesite associated dolomites in the samples of Sahasradhara section is of some importance. Valadiya (1968) has shown that the magnesite deposits in the calc zone of Pithoragarh, Kumaun Himalayas, U.P., are a back reef lagoonal or bay facies of a stromatolite biotherm. If this is true, the magnesite deposits represent members of a back reef evaporate sequence. Occurrence of magnesite rocks and magnesite bearing dolomites in the rocks of Sahasradhara section, further supports the earlier conclusion (Rao, 1964) that the Krols represent a phase in the development of an evaporate sequence.

The present work was accomplished in the Institute of Geology and Exploration of Combustible and Fuel Rocks (EGERGE), Academy of Sciences, U.S.S.R., during the tenure of an U.N.D.P. short-term fellowship in 1967 for the study of Sedimentary Mineralogy. The writer is thankful to the U.N.D.P. authorities for the award of a fellowship, to Professor G. I. Teodorovich for guidance in the work, and to Mrs. A. M. Kassianova for help in laboratory analysis.

Inst. of Petroleum Exploration,
O.N.G. Commission, Kaulagarh Road,
Dehra Dun, *October* 23, 1969.
C. GUNDU RAO.

1. Ranga Rao, A. M. and Murthy, K. N., "Report on certain traverses in the foot hills and sud-Himalayas of Dehra Dun, Garhwal, Tehri-Garhwal Dists.," *U.P. Report A. 29 Directorate of Geology, O.N.G. Commission*, 1960 (Unpublished).
2. Rao C. Gundu, "Petrography, facies, sedimentation and reservoir characteristics of the carbonate rocks of the Krol Series exposed in the sub-himalayas between Mussoorie and Lansdowne," *Report R. and T. Institute, O.N.G. Commission*, 1964 (Unpublished).
3. Teodorovich, G. I., *Authigenic Minerals in Sedimentary Rocks*, Consultants Bureau, New York, 1961, p. 120.
4. Valadiya. K. S., "Origin of the magnesite doposits of Southern Pithorgarh, Kumaun Himalaya," *India Eco. Geol.*, 1968, **63**, 924.
5. Wolf, K. H., Easton, A. J. and Warne, S., "Techniques of examining and analysing carbonate skeletons, minerals and rocks," in *Carbonate Rocks*, Edited by Chilingar, G. V., Bessell, N. J. and Fairbridge, R. W., Elsevier Publishing Co., Amsterdam, 1967, Part 9B, p. 315.

EFFECTS OF ENOVID ON LIVER NUCLEIC ACIDS, PROTEINS AND LIPIDS OF THE RAT

PROGESTAGEN-ESTROGEN combinations for contraception and also estrogen alone have been shown to cause abnormalities of certain liver function studies.[1,2] It has also been reported that during normal pregnancy in the rodent total RNA, DNA and proteins increase in liver, uterus and placenta.[3,4] However, reports on the effects of the contraceptive steriods on proteins, nucleic acids and lipids of somatic and reproductive organs are sparse. The present investigation is, therefore, an attempt to study those biochemical parameters of the liver following enovid* treatment as a preliminary step of its effects on protein and lipid metabolism involving liver.

Adult female rats of the Holtzman strain weighing 150–200 gm. were used in these investigations. The rats were divided into 2 groups of 6 animals each and were fed a standardized diet. One of the two groups received enovid at a dose of 0·02 mg. (0·0/197 mg. 17 *a*-ethynyl-17-hydroxy 5-estren-3-one *plus* 0·0003 mg. 17 *a*-ethynylestradiol-3-methyl ether dissolved in olive oil) per 100 gm. of body weight through subcutaneous route daily for 21 days. The other group served as untreated control. At autopsy the liver was dissected out and weighed. Suitable amounts of liver pieces were taken and processed for RNA, DNA, protein and lipid estimations. The nucleic acids and proteins were isolated according to the modified Schmidt-Thannhauser procedure.[5] RNA estimation was performed by a modified Mejbaum reaction.[6] DNA was determined by diphenylamine reaction as described by Dische and modified by Burton.[7] Biuret method was used to estimate the proteins.[8] Lipids were extracted from the liver by chloroform : methanol (2 : 1) three times. Then total lipid concentration was determined gravimetrically from suitable aliquots taken from the extract. Liver cholesterol concentration was measured according to the method of Sperry and Webb.[9]

The present investigations showed that enovid treatment significantly reduced liver RNA and protein concentrations, but it did not influence liver weight and its DNA concentration (Table I). Fisher and Leathem[10] reported that administration of progesterone and estrone to protein-depleted pregnant rats did not rectify liver protein and RNA lowering effects of protein depletion, although pregnancy was maintained. Total liver DNA content in these animals remained unchanged. They also discussed that estradiol is able to increase liver RNA and DNA, but marked increase in liver nucleic acids during pregnancy is dependent upon both placental secretions and ovarian estrogens. The present data, however, indicate that enovid reduces liver RNA content and in its wake liver protein content is adversely affected. The maintenance of liver DNA content at control level probably suggests that enovid does not induce any change in the number of hepatic cells. Therefore, it seems possible that the direction of liver RNA change and in its wake alteration of liver protein accumulation depends on the duration and the dose of the steroid treatment and how liver is able to detoxify them. Changes in nutritional state through estrogen-induced change in appetite may also play a role in this regard.

The results of the present study also showed that enovid induced a significant increase in total lipids and cholesterol concentrations of the liver (Table I). A fatty infiltration of the liver is found to occur in fed and fasted rats after pituitary extract and adrenocorticoid administrations ; impaired estrogen inactivation has also been associated with fatty liver.[11] The increase in liver lipids after enovid treatment reported here, therefore, may be due to reduced inactivation of the steroid by the liver or enhanced corticoid secretion by the adrenal mediated through enovid-induced adrenocorticotrophin release or both.[12]

TABLE I

Effects of enovid on liver nucleic acids, protein and lipids

Treatment	Liver						
	Weight		Nucleic acids		Protein	Lipid	Cholesterol
	Actual gm.	gm./100 gm. body weight	RNA mg./gm. tissue	DNA mg./gm. tissue	Total mg./gm. tissue	Total mg./gm. tissue	Total mg./100 mg. tissue
Enovid ..	7·14 ±0·307	4·05 ±0·110	4·33 ±0·122	3·19 ±0·237	16·5 ± 0·556	60·0 ± 1·91	0·226 ±0·025
Control ..	7·02 ±0·375	3·86 ±0·197	6·41 ±0·245	3·70 ±0·153	18·1 ± 0·287	50·6 ± 2·33	0·133 ±0·004

6 animals were taken in each group.

The author wishes to thank Professor B. R. Seshachar, Head of the Zoology Department, University of Delhi and Prof. M. R. N. Prasad of the same Department for facilities. He would like to express his indebtedness to Dr. H. C. Agarwal of this Department for his help in this work.

Department of Zoology, P. K. PAUL.
University of Delhi,
Delhi, *November* 17, 1969.

---

* Messrs. G. D. Serale Co., Chicago, U.S.A.

1. Garcia, C. and Wallach, E. E., *Fertil. and Steril.*, 1968, **19**, 172.
2. Mueller, M. N. and Kappas, A., *J. Clin. Invest.*, 1964, **43**, 1905.
3. Drasher, M. L., *J. Expr. Zool.*, 1953, **122**, 385.
4. Campbell, R. M., Innes, I. R. and Kosterlitz, H. W., *J. Endocr.*, 1953, **9**, 52.
5. Schmidt, G. and Thannhauser, S. J., *J. Biol. Chem.*, 1945, **161**, 83.
6. Merchant, D. J., Raymond, H. K. and Murphy, W. H., Jr., *Hand-book of Cell and Organ Culture*, Burgess Publishing Co., Minneapolis, p. 263.
7. Burton, K., *Biochem. J.*, 1965, **62**, 315.
8. Gornall, A. G., Bardawill, C. G. and David, M. M., *J. Biol. Chem.*, 1949, **177**, 751.
9. Sperry, W. M. and Webb, M., *Ibid.*, 1950, **187**, 97.
10. Fisher, C. J. and Leathem, J. H., *Endocrinology*, 1965, **76**, 454.
11. Leathem, J. H., "Nutritional effects on endocrine secretions," *Sex and Internal Secretions*, Ed. William C. Young, 1961, **2**, 666.
12. Paul, P. K., *Curr. Sci.*, 1969, **38**, 416.

OCCURRENCE OF *HETERELEOTRIS ZONATUS* (FOWLER) IN INDIAN WATERS

Hetereleotris zonatus (Fowler) has so far been recorded only from South African coast between Port Alfred and Zululand.[1,2] Five specimens of this species 37–49 mm. long have been collected from the tide pools at Visakhapatnam during 1965 ; this is the first record of *H. zonatus* from Indian waters. This species has been described as *Leiœleotris zonatus* by Fowler,[2] *Gobiosoma diadematum* by Regan[3] and Barnard[4] and *Heterelcotris diadematum* by Smith.[5] However, Smith[1] brought out the synonymy involved and has restricted it to *H. zonatus*. The Indian specimens differ from the earlier descriptions in minute details and hence a brief description is given here.

Hetereleotris zonatus (FIG. 1)

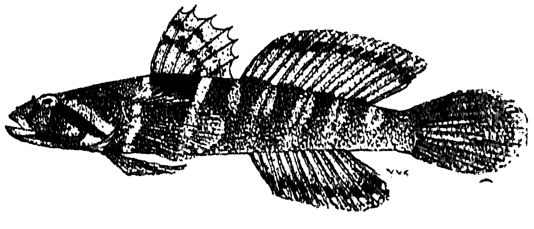


FIG. 1. *Heterelcotris zonatus* (Fowler), total length 49 mm.

D_1 6 ; D_2 1 + 13 ; A 1 + 11–12 ; P 17 ; V 1 + 5 ; C 17 ; LI about 47 ; Tr. about 18 ; Vert. 27.

Body elongate, cylindrical anteriorly, compressed posteriorly ; depth 5·3–6·7, head 3·5–3·9 in standard length. Head broad, depressed, narrow before eyes ; prominent rows of papillæ on snout, cheeks, opercle and top of head. Short vertical rows of papillæ along middle of body and a few on belly. Eye 4–4·5 in head, almost equal to snout, a little more than interorbital. Mouth oblique, lips rather thick, maxilla reaches to front edge of eye. Dentition as accurately described by Smith[1] : "In upper jaw, a single outer widespread series of curved caniniform teeth, 2 on side longest, inside a moderate band of villiform teeth, a few median behind enlarged. In lower jaw in front on each side 3–4 recurved caniniform teeth, inside these a band of villiform teeth, behind these on side 1–2 recurved caniniform teeth." Palate edentulous. Tongue truncate. Gill openings restricted to pectoral base, rakers absent, 7–9 round knob-like projections on either side of the gill arch.

First dorsal incersion well behind pectoral base, height equals depth of body; 2nd dorsal origin midway between eye and caudal base, height a little more than that of body. Anal origin below 3rd dorsal ray, height same as body. Pectoral rounded, shorter than head, upper two rays divided at half length, filamentous, the 1st attached a little above base to the 2nd whose lower branch is attached to the 3rd, tips of 3rd ray extend beyond the membrane. Ventral 2/3 in head. Caudal rounded, as long as head.

Body covered with embedded cycloid scales, none before line between 2nd dorsal origin and upper edge of pectoral base and anal origin and lower edge of pectoral base. Head, nape and pectoral base naked.

Head and body pink-brown, top of snout darker. A narrow dark brown band from front of eye to middle of maxilla, one broad band obliquely from behind eye to angle of opercle, preopercle darker. A dark brown area a little behind eye extends obliquely from top of head to upper half of opercle. A blackish spot, a little less than eye, above the extremity of preopercular groove. A broad blackish-brown band below spinous dorsal with narrow lighter areas in front and behind; behind this about 6 dark vertical bands alternate with lighter areas extending from dorsal profile to midside, merge in the lower half of body, the lighter areas usually with a dark vertical line in the middle. Fins pink-brown, spotted brown, 1st dorsal greyish with two curved dark bands from upper half to behind 5th spine. Second dorsal, anal and caudal with lighter free margins, the first two with black submarginal bands. Anterior third of pectoral densely spotted becoming lighter posteriorly, a lighter area behind the darker base.

In addition to having darker colouration and more area devoid of scales on body, the Indian specimens also have 1–2 extra rays in the anal fin and two filamentous rays in the pectoral.

I am grateful to Professor P. N. Ganapati for facilities and to C.S.I.R.. for financial assistance.

Dept. of Zoology, V. VISWESWARA RAO.*
Andhra University,
Waltair, *November* 3, 1969.

---

[*] Present address: Central Regional Station, Zoological Survey of India, Jabalpur.

1. Smith, J. L. B., *Rhodes Univ. Ich. Bull.*, 1958, No. **11**, 160.
2. Fowler, H. W., *Proc. Acad. Nat. Sci.*, Philadelphia, **1934**, **86**, 494.
3. Regan, C. T., *Ann. Durb. Mus.*, 1919, **2**, 200.
4. Barnard, K. H., *Ann. South African Mus.*, 1927, **21**, 829.
5. Smith, J. L. B., *Sea Fishes of Southern Africa*, 1949, p. 338.

ON THE PRESENCE OF VITAMIN A IN THE MEDIAN EYES OF THE SCORPION, *HETEROMETRUS FULVIPES*

ABSTRACT

Purified preparations of vitamin A were made from the median eye-tissues of the scorpion, *Heterometrus fulvipes* through column chromatography. It was identified to be vitamin A through the Carr-Price test. *Heterometrus fulvipes* is the first arachnid in which the presence of vitamin A has been reported.

IN contrast to the vertebrates the role of vitamin A in invertebrates remains rather uncertain, Conflicting reports about the presence or otherwise of vitamin A in insects have appeared.[1] But in the crustaceans about 90% of the vitamin A of the entire body is found in the eyes.[2] While this is the state of our knowledge about the presence and the role of vitamin A in these two major groups of arthropods, nothing is known about other arthropods. However, retinene$_1$ (vitamin A_1 aldehyde) has been reported in *Limulus polyphemus*.[3]

In this note the presence of vitamin A_1 in the median eyes of an arachnid, the scorpion, *Heterometrus fulvipes* is reported.

Heterometrus fulvipes were collected from the hills around Tirupati. They were maintained in glass vivaria, containing a one inch layer of moist soil at the bottom, and were fed with cockroaches once in four days. Animals were always used within a fortnight of their capture from the source.

The method followed for the extraction and chromatography was as described by Cohen and Barker.[1] The median eyes were separated from the animals and the tissue was ground with anhydrous sodium sulphate and extracted with acetone. After evaporation, the residue was taken up in petroleum ether. The extract was introduced into a column of aluminium oxide and was eluted with 4%, 10% and 25% acetone in petroleum ether. After evaporating the solvent in each eluate under vacuum, benzene was added and flushed with nitrogen.

Immediately, after the addition of Carr-Price reagent (antimony trichloride in chloroform) to the benzeneeluate, taken in a microcuvette, optical density measurements were made from

600 to 700 mμ using a Hilger Watt UVISPEK spectrophotometer. All the experiments were carried out at 20 ± 2° C.

Table I summarizes the results of six experiments. The 4% acetone fraction seems to contain traces of retinene$_1$ and the 25% fraction contains traces of vitamin A. However, the 10% fraction contains most of the retinene$_1$ and vitamin A_1 with their characteristic maxima at 660 mμ and 620 mμ respectively.[4,5]

TABLE I

Maximum optical density and the absorption peak of the median eye-extracts of the scorpion, Heterometrus fulvipes, *eluted from an alumina column*

Experiment No.	Number of the median eyes used	Absorption peak in mμ			Optical density at the absorption peak		
		4% Acetone eluate 250 ml.	10% Acetone eluate 200 ml.	25% Acetone eluate 150 ml.	4% Acetone	10% Acetone	25% Acetone
1	24	650–660	610–620 660	620–630	0·02	0·12 0·15	0·01
2	24	None	620 660	620–630	..	0·13 0·14	0·01
3	36	650	630 660	610	0·02	0·22 0·25	0·01
4	40	None	620 660	None	..	0·20 0·255	..
5	30	650–660	620 650–660	620–630	0·015	0·24 0·21	0·015
6	36	630–640	620 660	None	0·02	0·25 0·225	..

It is significant that the scorpion, *Heterometrus fulvipes* possesses vitamin A_1 in the median eyes. It is well known that vitamin A in conjunction with a specific protein forms rhodopsin which is essential for rod vision. Unlike in insects, in which, the 'retinene system of rod vision is not solely essential for rod vision',[1] arachnids, so far as is known, are apparently similar to the crustaceans and vertebrates in their visual system. This aspect of vision in relation to the visual pigment in the scorpion, *Heterometrus fulvipes* has been discussed elsewhere.[6]

My sincere thanks are due to Prof. K. Pampapathi Rao, Bangalore University, for his guidance and for critically reading through the manuscript. I am grateful to Dr. R. V. Krishna Murthy, Department of Zoology, Bangalore University, for helpful discussions.

Dept. of Zoology, T. RAMAKRISHNA.*
Sri Venkateswara University,
Tirupati (A.P.), *November* 16, 1969.

---

* **Present** address: Department of Biophysics, All-India Institute of Mental Health, Bangalore-27.

1. Cohen, C. F. and Barker, R. J., *J. Cell Comp. Physiol*, 62, 1963, p. 43.
2. Brown, F. A., Jr. and Prosser, C. L., *Comparative Animal Physiology* (Ed. Prosser and Brown), W. B. Saunders Company, London. 1961.
3. Hubbard, R. and Wald, G., *Nature*, 1960, **186**, 212.
4. Wald, G., *J. Gen. Physiol.*, 1935, **19**, 351.
5. —, *Ibid.*, 1936, **19**, 781.
6. Ramakrishna, T., "Studiets on the physiology of vision in scorpion," *Ph.D. Thesis*. Sri Venkateswara University, Tirupati, A.P., India.

TONGUE PIGMENTATION IN MAN: A NEW GENETIC TRAIT

THE main purpose of this note is to announce the discovery of a new genetic trait in human populations, tongue pigmentation. Tongue pigmentation, *i.e.*, dark spots and patches on the surface of human tongue, was first noticed in human populations by Davis (1968). A subsequent study of the present author (Rao. 1969 *a*) suggests the genetic nature of this trait.

It may be mentioned that of the several 'tastes' the tongue can taste, the capacity to taste the chemical compound, phenile-thio-carbamide (P.T.C.), was established to be a genetic character (autosomal, diallelic, dominant trait). For genetic studies on P.T.C. one may refer to Das (1956, 1958). With the present knowledge, one could observe three types of pigments (colour) on the tongue. (1) *Black patches*—It is suspected (Sanghvi, 1969) that these patches are associated with cancer. Active research is being carried by the Cancer Research Institute, Tata Memorial Centre, Bombay, on this aspect. (2) *White spots and patches*—In most of these cases, it is well known to be due to vitamin deficiency, thus not being of hereditary importance. And, (3) *Dark* (not black) *spots and patches*—These patches are usually of ash colour. It is about these pigments on tongue, that the present note is written.

Tongue Pigmentation.—Pigments of the third type mentioned above constitute 'tongue pigmentation' (Davis, 1968). One may have exclusively spots or patches or both. The position is anywhere on the upper surface or the borders (sides) of the tongue. It may be pointed out that one may have one spot to many, and/or a small patch of 2 sq. mm. to as big a one as to cover nearly half the surface area of the tongue. Figure 1 illustrates these spots.

One may know that there is a great variation in the geographical distribution of this trait. For example, roughly, 22% are tongue pigmented in Kerala whereas only 13% in West Bengal and 14% in Maharashtra. Undoubtedly, this unequal distribution raises some pertinent problems.

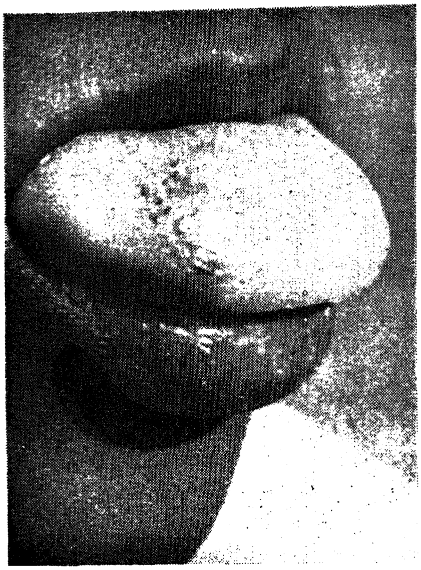


FIG. 1

The author has collected several pedigrees and huge family data from various parts of the country, a preliminary report on which is ready (Rao, 1969 *a*). It is interesting to note that the sex and age factors do not show any significant differential incidence rates of tongue pigmentation (Rao, 1969 *b*). Analysis of the data, on the lines of Smith (1956), suggests the following :

Genetic Hypothesis.—Tongue pigmentation is an autosomal diallelic recessive character in man, controlled by two alleles '*a*' and 'A' where 'A' is dominant over '*a*'.

The author is greatly indebted to Professor C. R. Rao, F.R.S., for suggesting this problem.

Indian Statistical Institute, D. C. RAO.
203, B.T. Road, Calcutta-35,
November 20, 1969.

---

1. Das, S. R., *Ann. Hum. Genet.*, 1956, **20**, 334.
2. —, *Ibid.*, 1958, **22**, 200.
3. Davis, T. A., *Haldane and Modern Biology*, Edited by K. R. Pronamraju, The Johns Hopikns Press, 1968, p. 327
4. Rao, D. C., Submitted to Human Heredity, 1969 *a*.
5. —, Unpublished, 1969 *b*.
6. Sanghvi, L. D., Personal communication, 1969.
7. Smith, C. A. B., *Ann. Hum. Genet.*, 1956, **20**, 257.

THE NATURE OF PEST RESISTANCE IN AN *INDICA* RICE VARIETY *TKM*. 6

STEM borers are one of the major pests of most rice-growing tracts in the world. Evolution of pest-resistant strains of rice is one of the means to check the losses due to these pests. For this purpose, a good donor-resistant parent is essential which is to be crossed with other varieties having desirable agronomic characters. Accordingly, an extensive screening test of the large genetic stock of this Institute was carried out, and one *indica* variety, *TKM*. 6 (a selection from a cross between *CO*. 10 × *GEB*. 24, evolved at Tirurkuppam, Tamil Nadu) was isolated as less susceptible to the predominant stem borer *Tryporyza incertulas* Walk. (Israel, 1960). The mechanism of resistance was attributed to a comparatively broad and thick sclerenchymatous hypodermis in the stem (Israel *et al.*, 1961), to the narrow central lumen in the culm, narrow and hairy leaves (Israel, 1964) and also to lower nitrogen content in the stems (Roy and Israel, 1966). Pathak (1964), working on the same problem, recorded that closer disposition of vascular bundles and the presence of more silicated cells in the leaf epidermis in *TKM*. 6 are responsible for the low incidence of *T. incertulas* and *Chilo suppressalis* Wlk., two of the rice stem borer species prevalent in the Philippines.

It has been recently established both in India and in the Philippines that the stem borer resistance in rice is inheritable. The need was to transfer resistance to the high yielding but susceptible varieties like *Taichung* (*native*) 1 and *IR*. 8. From the crosses between *TKM*. 6 and these high-yielding parents, a number of semi-dwarf cultures have been selected at this Institute which have been tested in some endemic areas of this pest in India and are found to combine both the high-yielding as well as the resistant characters of the parents (Roy *et al.*, 1969).

Though the role of morphological and anatomical plant characters in imparting resistance to borers is convincing in this *indica* variety, these characters are also found in varying degrees, in some susceptible rice varieties as well. One other factor responsible for resistance in this variety seems to be of biochemical nature. Antibiosis tests conducted in the Philippines showed that the growth and development of stem borer larvæ were much slower in the variety *TKM*. 6 compared to the other varieties tested (Pathak, 1967). Since no further information is available on this aspect, the resistance due to the biochemical mechanisms seems empirical and it is desirable to ascertain further details.

A series of tests were conducted during 1967 using artificial infestation of rice seedlings with nematodes. One typical rice pest, the root-knot nematode (*Meloidogyne graminicola* Golden and Birchfield) was used to infest the soil and the seedlings. Subsequent examination of the roots for the invasion and development of the nematode brought out clear differences between varieties in the degree of susceptibility (Israel *et al.*, 1969). These tests revealed that about six recent varieties were highly resistant to nematodes and *TKM.* 6 was consistently resistant. The significance of this finding is that since the delicate root cells of both the resistant and the susceptible varieties are easily penetrable by the nematode, their multiplication is inhibited in the resistant variety, by some cell constituent. Therefore it can be inferred that there is a biochemical defence mechanism against the nematode in *TKM.* 6. Since Pathak (*loc. cit.*) reported that the tissue contents of *TKM.* 6 is not suitable for the proper growth and development of the stem borer larvæ, it is reasonable to link the two, the resistance against stem borers and nematodes and attribute similar biochemical mechanisms against these two classes of rice pests.

The isolation and identification of the inhibiting constituents need elaborate biochemical analysis requiring sophisticated equipments. An alternative method is by bioassay, similar to the antibiosis study against stem borers (Pathak, 1964; Israel *et al.*, 1969). Testing with the larvae of stem borers is likely to be difficult as the technique of mass rearing of *Tryporyza* larvæ is not yet perfected.

A quite reliable method is needed to study the genetics of insect resistance. The results on the whole show that resistance in the *indica* rice variety, *TKM.* 6 to rice stem borers and the root-knot nematodes mainly operates at the biochemical level. It is established that certain chemicals such as benzoic and salicylic acids which can be isolated from the rice plants, inhibit the growth of the larvæ of stem borers (Ishii *et al.*, 1962). The present results are not conclusive. Further work has to be done to ascertain whether same biochemical defence operates against both the pests. A fuller understanding of the exact mechanism of resistance is highly desirable as it may be of practical use.

Central Rice Research Inst., S. SAMPATH.
Cuttack-6, Y. S. RAO.
November 3, 1969. J. K. ROY.

---

1. Ishii, S., Chisato, H., Masanori. N. and Miyagawa, H., *Jap. Jour. Ent. Zool.*, 1962, **6** (4), 281.
2. Israel, P., *Annual Report of the Central Rice Research Institute*, Cuttack, 1960.
3. —, *Proc. of the Symposium on the Major Insect Pests of Rice*, Manila, 1964.
4. — and Vedamurthy, G., *Proc. IRC Working Party*, New Delhi, 1961.
5. —, Rao, Y. S., Biswas, H., Panda, H., Rao, Y. R. V. J., Das, P. K. and Rao, Nageswar, *Plant Disease Reporter*, 1969 (In press).
6. Pathak, M. D., *Proc. of Symposium on the Major Insect Pests of Rice*. IRRI. 1964.
7. —, *Annual Report of the IRRI*, Philippines, 1967.
8. Roy, J. K. and Israel, P., *Annual Report of the CRRI*, Cuttack, 1964.
9. — and —, *Ibid.*, 1966.
10. —, — and Panwar, M. S., *Oryza*, 1969, **6** (2) (In press).

EFFECTS OF GAMMA-RAY IRRADIATION ON PROTEIN AND AMINO-ACID CONTENT OF MAIZE LEAVES

THE stimulation of plant growth through the application of gamma-ray irradiation of seeds has been reported by many investigators.[1,2] Variation in the sensitivity of plants to radiation has also been extensively investigated by Sparrow and his colleagues.[3-5] The present investigation was undertaken to determine the possible effects of gamma irradiation on protein and amino-acid content of maize leaves.

Healthy uniform seeds of hybrid maize, Ganga-1 obtained from the U.P. Agricultural University, Pantnagar, were exposed to 0 KR, 20 KR and 30 KR doses of gamma radiation from a Co^{60} source. After irradiation, the seeds were stored in plastic bags at 23° C.

Medium-sized 23″ × 18″ cemented pots were filled with 1 : 1 mixture of loam and compost. Surface-sterilized seeds were sown one inch deep on 1st July, 1968 under natural conditions of climate at Varanasi. The usual cultural operations were performed at regular intervals.

The total nitrogen was determined by the modified Kjeldahl method[6] and protein was calculated by multiplying the nitrogen value to 6·25. Amino-acids were determined chromatographically as described by Porter *et al.*[7]

Figure 1 shows that protein content increased with the doses of radiation and the highest content of 15·7% was obtained in 30 KR irradiated leaves at ear formation stage. It is also observed that protein content of maize leaves increased with advance in age irrespective of treatment. Similar results were also reported by Vasilev.[8] Kuzin,[9,10] Hagen and Gunckel[11] and Giacomelli *et al.*[12] have, however, reported a depression of protein synthesis caused by radiation.

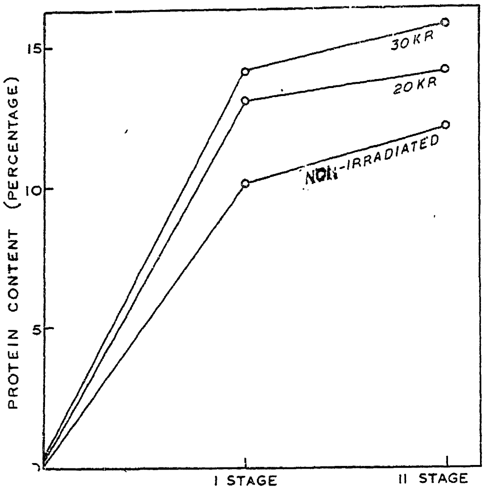


FIG. 1. Effect of gamma-ray irradiation on protein content of maize leaves.

TABLE I

Effect of gamma-ray radiation on amino-acid content (ppm) of maize leaves

Amino-acids	Tasseling stage			Ear formation stage		
	0 KR	20 KR	30 KR	0 KR	20 KR	30 KR
1. Lysine ..	9,990	9,990	9,990	9,995	9,990	9,990
2. Arginine + Histidine ..	10,950	27,375	27,375	32,850	32,850	32,900
3. Aspartic acid + glutamine ..	5,715	11.430	11,430	11,430	19,525	19,525
4. Threonine + alanine ..	12,840	19,260	22,470	19,260	22,260	24,050
5. Proline ..	30 000	30,000	30,000	30,000	30,000	30 000
6. Cystine ..	30,000	45 000	45,000	45,000	47 000	47,000
7. Tyrosine ..	19 800	29,700	29,700	29,700	34,650	31,750
8. Tryptophane ..	21,450	30,030	30 030	30,030	34,320	30,030
9. Valine ..	8.880	13,320	12,210	12,210	14,200	13,500
10. Methionine ..	2,850	2,860	4,275	4 375	5,700	5,700
11. Phenylalanine ..	6,000	6,000	6,000	6 000	6,000	6,000
12. Leucine ..	990	1,980	1,980	1,980	1,995	1,990

The amino-acid contents of control and irradiated leaves are presented in Table I.

Marked increase in the concentrations of arginine and histidine, aspartic acid and glutamine, cystine, tyrosine, tryptophane and leucine occurred at 20 KR radiation. At 30 KR all of the above-mentioned amino-acids remained constant. But there was some reduction in the concentration of valine beyond 20 KR radiation. Similar reduction was also noticed by Hagen and Gunckel[11] working with gamma irradiated *Nicotiana glauca*, *Nicotiana langsdorfie* and their inter-specific hybrid. They explained that with the onset of morphological changes in the plant, because of irradiation, free amino-acids began to accumulate in the leaves, particularly glutamine, glutamic acid, aspartic acid and glycine. However, threonine, alanine and metheonine increased with increasing doses of radiation till ear-formation stage.

It still remains unexplained why there is a build up of free amino-acids upon irradiation. It is believed that this build up may be due to aging phenomenon.[14] The other effects may be on the mechanism of auxin synthesis.[13,14] Davies's claim[15] that primary effect of radiation was on the development of meristematic cell and the effect of auxin supply may be a consequence of the same, is also equally compatible.

The author wishes to place on record his deep debt of gratitude to Prof. R. S. Choudhri, Irwin Professor of Agriculture, Banaras Hindu University, for his valuable guidance and to Prof. T. S. Sadasivan, Director, University Botany Laboratory, Madras, for critically going through the manuscript.

Cellular Physiology Lab.,
Faculty of Agriculture,
Banaras Hindu University,
Varanasi, *October* 30, 1969.
B. B. SINGH.

---

1. Woodstock, L. W. and Justice, O. L., *Radiation Botany*, 1967, **7**, 129.
2. Johnstone, G. R. and Klepinger, F. W., *Ibid.*, 1967, **7**, 385.
3. Sparrow, A. H., *Jap. J. Genet.*, 1965, **40**, 12.
4. Sparrow, R. and Sparrow, A. H., *Science*, 1965, **147**, 1449.

5. Sparrow, A. H. and Woodwell, G. M., *Radiation Botany*, 1962, **2**, 9.
6. A.O. A.C., *Official Methods of Analysis*, 7th. ed., 1950, **7**, 343.
7. Porter, C. A., Margolis, D. and Sharp, P., *Contrib. Boyce Thompson Inst.*, 1957, **18**, 465.
8. Vasilev, I. M., *AEC-tr-5836 Biology and Medicine*, United States Atomic Energy Commission, 1962, p. 40.
9. Kuzin, A. M., *Reviews on Radiobiology. Acad. of Sci., USSR*, Moscow (English translation), 1956, **125**, 4.
10. —, *Conf. Acad. Sci. USSR. Peaceful Uses of Atomic Energy*, Moscow, 1955. *Ses. Div. Biol. Sci.*, (English translation), 1956, p. 59.
11. Hagen, C. L. and Gunckel, J. E., *Plant, Physiol.*, 1958, **33**, 439.
12. Giacomelli, M., Maria, L., Donani, B., and Cervigni, T., *Radiation Botany*, 1967, **7**, 375.
13. Gordon, S. A., *Quart. Rev. Biol.*, 1957, **32**, 3.
14. Leopold, A. C. and Thimann, K. V., *Amer. J. Bot.*, 1949, **36**, 342.
15. Davies, C. R., *Radiation Botany*, 1968, **8**, 17.

EFFECT OF CYCLOHEXIMIDE ON NUCLEIC ACID AND PROTEIN SYNTHESIS IN *SPHACELIA SORGHI* McRAE

THE sorghum sugary disease caused by *Sphacelia sorghi*, was found to be effectively controlled by cycloheximide both under laboratory and field conditions. Investigations on the mode of action of this antibiotic indicated its interference with the respiratory metabolism of the fungus.[1] In the present study, the effect of cycloheximide on the synthesis of nucleic acid and protein in *Sphacelia sorghi* is reported.

A pathogenic strain of the fungus was cultured in Kirchhoff's liquid medium[2] for 20 days. The antibiotic was added at suitable concentrations to the medium under aseptic conditions and incubated for 5 more days at 28 (± 2)° C. After the incubation period the fungal mats were removed by filtration and the tissues were washed twice with distilled water. The preliminary extraction of nucleic acid from the fungal tissues was patterned after the procedures of Ogur and Rosen.[3] For the separation of the nucleic acid into component ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) fractions, the method of Nieman and Poulson[4] was followed with some modifications. The material precipitated from samples weighing 0·5 g. was resuspended in 0·3 N NaOH and incubated at 37° C. for 16 hours. The solution was acidified to pH 1·0 with 15% (V/V) perchloric acid. After leaving for 60 minutes at 4° C., the precipitate was centrifuged down and washed once again with 1 N perchloric acid. The combined supernatant fluids constituted the RNA fraction. The DNA was hydrolysed from the residue with 0·5 N. perchloric acid at 70° C. for 15 minutes. Both RNA and DNA were estimated spectrophotometrically by measuring the extinction of the extract at 260 mμ with a Beckman DU spectrophotometer and expressed as nucleic acid phosphorus.[4] The protein content was determined by estimating the protein nitrogen. Proteins were precipitated with 5% trichloro acetic acid.[5] The supernatant was used to estimate non-protein nitrogen. The value was deducted from total nitrogen. The total nitrogen and non-protein nitrogen were estimated by micro-Kjeldahl method.[6] The results are given in Table I.

The results indicate that cycloheximide inhibited the synthesis of DNA and protein while the RNA content was increased. The inhibition and increase were more or less proportional to the concentration of the antibiotic. The inhibition of DNA and protein synthesis accompanied by an increase in RNA content has been reported in yeast cells treated with cycloheximide.[7] Besides cycloheximide, other antibiotics like naramycin, blasticidin S (BcS) have been known to cause increase in RNA content of the treated tissues.[8,9] Hirai and Shimomura[8] postulated that the antibiotics may suppress the decomposition of RNA resulting

TABLE I

Effect of cycloheximide on the nucleic acid and protein content of Sphacelia sorghi

Cyclohexide concentration (μg/ml.)	RNA		DNA		Protein	
	RNA–P (μg/g. fresh weight)	Increase (%)	DNA–P (μg/g. fresh weight)	Inhibition (%)	Protein-N (μg/mg. dry weight)	Inhibition (%)
Nil	90·173	..	4·828	..	8·447	..
1·0	139·511	54·7	4·310	10·7	5·537	34·5
5·0	271·494	201·1	3·448	28·6	3·741	56·7
10·0	277·456	207·7	2·931	39·3	2·816	67·4
50·0	280·140	210·7	1·552	69·9	1·680	79·9

(Mean of three independent determinations.)

in an accumulation. Hashimoto *et al.*[9] reported that the increase in RNA content of BcS treated blast fungus was associated with ribosome particles of fungus homogenate. However, the reason for the RNA increase in cycloheximide treated tissues of *Sphacelia sorghi* remains unknown.

My thanks are due to Dr. K. Ramakrishnan and Dr. C. V. Govindaswamy for their valuable suggestions and encouragement.

Division of Plant Pathology,
Agricultural College and Res. Inst.,
Coimbatore-3, *November* 3, 1969.
G. CHINNADURAI.

---

1. Chinnadurai, G., *Studies on Sugary Disease of Sorghum* M.Sc. (Ag.), Thesis, Univ. Madras, 1969.
2. Hirchhoff. H., *Zentbl. Bakt. Parasi Kde, Abt. II*, 1929, **77**, **310**.
3. Ogur, M. and Rosen, G., *Arch. Biochem.*, 1950, **25**, 262.
4. Nieman, R. H. and Poulson, L. L., *Plant Physiol.*, 1963, **38**, 31.
5. Pregl, F., *Quantitative Organic Micro Analysis*, J. & A. Churchill, Ltd., London, 1945.
6. Humphries, E. C., *Modern Methods of Plant Analysis —I*, Springer-Verlag, Berlin, 1956.
7. Siegel, M. R. and Sisler, H. D., *Biochim. Biophys. Acta*, 1964, **87**, 70.
8. Hirai, T. and Shimomura, T., *Phytopath. Z.*, 1960, **40**, 35.
9. Hoshimoto, K., Katagiri, M. and Misato, T., *Agr. Chem.* (Tokyo), 1963, **37**, 245.

OUT OF SEASON FLOWERING IN THE STEM CUTTINGS OF *SALIX TETRASPERMA* ROXB.

OUR understanding of the initiation of flowering is mainly based on experiments on annual or perennial herbs subjected to varied temperature or photoperiodic conditions.[1] Events which lead to the flowering of trees are difficult to understand not only because of their unmanageably complex organization but also because of juvenility. The present report deals with some interesting observations made on the flowering of intact willow (*Salix tetrasperma* Roxb.) trees and their stem cuttings.

Owing to their availability throughout the year and their high capacity for regeneration,[2] *Salix* plants were used as experimental material. All stem cuttings (each consisting of 5 or 6 nodes and measuring 1·1–1·2 cm. in diameter) were taken from 15–20 years old male trees growing in the University campus. A dormant bud was present in the axil of each leaf. The cuttings were kept in beakers containing distilled water in upright position under culture room conditions.

In Delhi, *Salix* trees come to flower during the first week of December and continue to bear until mid-February. Interestingly, the cuttings developed inflorescences in the regenerated shoots irrespective of the season. However, the precentage of cuttings which produced inflorescences varied in the different seasons. The peak was found during January. Similarly, the length and the number of inflorescences in a cutting were also subject to variation, the maximum being in January. In nature, the inflorescence arises directly in the axil of a leaf. In the explanted stems, however, it is borne terminally on the regenerated axillary shoots (Fig. 1). The flowers were fertile; 20–40% of the pollen germinated in tap-water during different seasons.

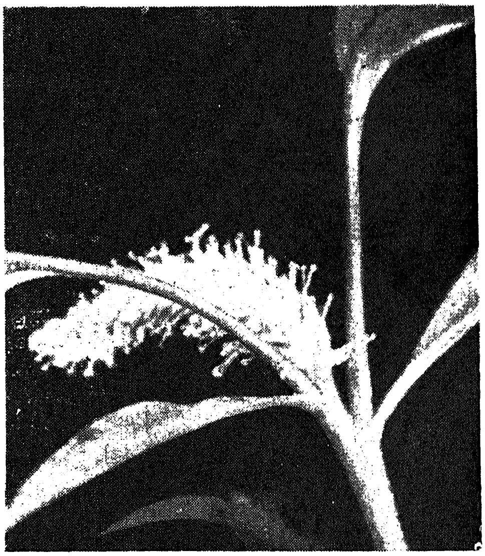


FIG. 1. View of an inflorescence which has developed at the end of a regenerated axillary shoot.

To ascertain whether or not the inflorescence primordia are already laid down in the summer months, some axillary buds were removed from the trees and were sectioned longitudinally. However, the buds were invariably found to be in the vegetative state.

Since the cuttings were kept at 22° C., it was suspected that lowering of temperature was responsible for initiating the inflorescence in the stem cuttings. To verify this, batches of cuttings were kept in the laboratory at 31° C. and also below *Salix* trees in the garden. Even these cuttings showed the development of inflorescences which suggested that the mere act of separating the stems from the tree was responsible for flower initiation. Neither ringing of the bark during summer months nor removal of apical bud or leaves[3] could force the axillary buds to bloom under intact conditions.

No explanation can be offered at this stage for the differentiation of vegetative apex of the axillary bud into an inflorescence even during summer. Whether the leaves or terminal bud have any role to play in inhibiting flowering in intact stems during summer remains to be investigated.

I thank Professor H. Y. Mohan Ram for valuable guidance and Professor B. M. Johri for facilities and encouragement.

Department of Botany, N. SEETHARAMA.
University of Delhi,
Delhi-7, *October* 19, 1969.

---

1. Lang, A., "Physiology of flower initiation." In *Handbuch Der Pflanzenphysiologie* Vol. 15, ed., Rubland, W., Springer-Verlag, Berlin, N.Y., 1965, p. 1380.
2. Sinnott, E. W., *Plant Morphogenesis*, McGraw-Hill Book Company, N.Y., 1960, p. 550.
3. Salisbury, E. A., *The Flowering Process*, Pergamon Press, Oxford, London, N.Y., 1963, p. 234.

FOUR NEW RECORDS OF PARASITES ATTACKING *HELIOTHIS ARMIGERA* (HÜBNER) IN HIMACHAL PRADESH (INDIA)*

A DETAILED account of the parasites of *Heliothis armigera* (Hübner) and also the host plants of this pest recorded in India was presented by Achan *et al.* (1968).[1] During his studies at Palampur (Himachal Pradesh) in 1968 the present author reared four new parasites of *H. armigera* and also recorded a few additional host plants of this pest. A brief account of the new parasites and host plants recorded is presented in this paper.

H. armigera became active around Palampur during the second week of April when the adults were noticed at light. The larvæ were first obtained feeding on floral clusters of *Lantana camara* L. during the last week of April. However, the population was low. Subsequently the larval population rose and the maximum infestation was noticed on *Triticum æstivum* L. The pest larvæ were also found feeding on *Abelmoschus esculentus* (L.), *Chrysanthemum indicum* L., *Citrus limon* (L.), *Cnicus wallichii* DC. var. *cernua* HK., *Lycopersicon esculentum* Mill., *Phaseolus vulgaris* L., *Rosa banksiæ* R. Br., *Solanum tuberosum* L. and *Vigna sinensis* (L.). Of these, *T. æstivum*, *C. wallichii* var. *cernua*, *C. limon*, *C. indicum*, *R. banksiæ* and *V. sinensis* are new host records for *H. armigera.*

Apart from *Ecphoropsis perdistinctus* Vier. and *Apanteles ruficrus* Haliday which were recorded earlier, the following four parasites were reared for the first time from *H. armigera*:

1. *Euplectrus* sp. (Hymenoptera: Eulophidæ): This is an external, gregarious, larval parasite. The eggs are normally laid on the head of the active host larva. After killing the host when full-grown, the parasite larvæ spin loose cocoons under the host remains and pupate. The larval period was 5 to 6 days and the pupal period 7 to 8 days. The adults lived up to 15 days when fed diluted honey.
2. *Agrypon nox* Morl. (Hymenoptera: Ichneumonidæ): This is an internal, solitary, larval parasite, but the adult emerges from the host pupa. Three examples only were reared.
3. *Netelia* sp. (Hymenoptera: Ichneumonidæ): This is a solitary, larval parasite which feeds externally. It was recorded earlier from *H. assulta* (Guen.) in India (Achan *et al.*, 1968).[1]
4. *Palexorista* sp. (Diptera: Tachinidæ): This is an internal, solitary, larval parasite. Only one example was reared. On identifying this parasite, the specialist at the Commonwealth Institute of Entomology, London, remarked that this species of *Palexorista* is almost certainly not *laxa* Curran, which to date has been the only species of the genus known from *Heliothis* in India.

The percentage of parasitism by all the four parasites mentioned above was negligible and therefore it is doubtful whether they exert any appreciable control of *H. armigera* in India. However, it is difficult to predict how these parasites might behave in an exotic environment, and they therefore merit further detailed study.

The author is thankful to Dr. R. G. Fennah, Director, Commonwealth Institute of Entomology, London, for identifying the parasites.

Commonwealth Institute of K. C. MATHUR.
Biological Control,
Indian Station,
Bangalore (India),
November 4, 1969.

---

* This research has been financed in part by a grant made by United States Department of Agriculture under PL-480.

1. Achan, P. D., Mathur, K. C., Dharmadhikari, P. R. and Manjunath, T. M., *Tech. Bull. Commonw. Inst. biol. Control*, 1968, **10**, 129.

REVIEWS AND NOTICES OF BOOKS

Number Theory and Analysis : A Collection of Papers in Honour of Edmund Landau (1877-1938). Edited by Paul Turan. (Plenum Publishing Corporation, 227, West, 17th Street, New York, N.Y. 10011, U.S.A.), 1969. Pp. 355. Price $ 19.50.

At the end of the foreword to his work "Handbuch der Lehre von der Verteilung der Primzahlen' (1909), Edmund Landau could remark with complete justification, "The difficulty of the previously unsolved problems has frightened nearly everyone away from the theory of prime numbers. I hope that I have succeeded in paving the path to the boundaries which have now been reached in such a way that this path will now be travelled and extended by many." Subsequent developments have shown that his wish was fully realized.

Dedicated to the memory of a great scholar and teacher, this volume presents the recent developments in the theory of prime numbers. The papers discuss such problems as extending a calculus, the large sieve method, and the high-indices theorem. The volume will be of particular value to pure and applied mathematicians.

C. V. R.

Annual Review of Physical Chemistry (Vol. 20). Edited by Henry Eyring. (Annual Reviews, Inc., 4139 El Camino Way, Palo Alto, California 94300, U.S.A.), 1969. (Pp. vii + 520. Price : $ 8.50 ; in U.S.A. and $ 9.00 ; elsewhere. (Note : Because of increased operating and printing costs, all publications of Annual Reviews, Inc., shipped after January 1, 1970 (inclusive of back volumes) will be increased in price by $ 1.50 per copy, over and above the prices indicated in the Prospectus.

This volume under review concludes the second decade of *Annual Reviews of Physical Chemistry*.

A change in the *Review* is the addition of the introductory chapter dealing with the beginnings of physical chemistry in various parts of the world. This year Professor Norrish discusses Fifty Years of Physical Chemistry in Great Britain, which should be of general interest.

Volume 20 of this well-known series deals with the following topics : Fifty Years of Physical Chemistry in Great Britain, by R. G. W. Norrish ; Topics in Mossbauer Spectroscopy, by D. A. Shirley ; Elementary Gas Reactions, by Frederick Kaufman ; Electrochemistry, by Andrew Patterson, Jr. ; Solutions of Non-Electrolytes, by Robert L. Scott and David V. Fenby ; Microwave Spectroscopy, by Y. Morino and E. Hirota ; Theories of Liquids, by G. A. Neece and B. Widom ; Intermolecular Forces, by Christoph Schlier ; Electron Spin Resonance, by M. C. R. Symons ; Shock Tube Technique in Chemical Kinetics, by R. Linn Belford and Roger A. Strehlow ; Vibrational Spectroscopy, by Arthur G. Maki, Jr. ; Cosmochemistry, by James R. Arnold and Hans E. Suess ; Quantum Theory of Structure and Dynamics, by Leland C. Allen ; Electronic Spectroscopy by Electron Spectroscopy, by R. Stephen Berry ; Optical Activity, by C. W. Deutsche, D. A. Lightner, Robert W. Woody, and Albert Moscowitz ; and Isotope Effecas, by Max Wolfsberg.

C. V. R.

Molten Salts : Characterization and Analysis. Edited by Gleb Mamantov. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xvi + 611. Price $ 16.75. Sterling Price £ 8.0.0.

Molten salts are of considerable importance in chemical technology. Applications range from the production of aluminium, sodium, magnesium, and fluorine, to the plating of refractory metals, chemical synthesis, and fuel cells. Of potentially great importance are the uses in nuclear technology. From the fundamental point of view molten salts represent a large and unique class of non-aqueous solvents, in which interesting redox and acid-base chemistry may be pursued.

This book contains a collection of papers of a review and research nature on most aspects of molten salt chemistry. The titles of the chapters contained in the book are : Some Fundamental Concepts in the Chemistry of Molten Salts ; The Experimental Evidence for "Complex Ions" in Some Molten Salt Mixtures ; The Role of Phase Equilibria in Molten Salt Research ; Ionic Interactions in Molten Salts ; Co-ordination Equilibria of Nickel (II) in Molten Chloride Salts ; Electronic Absorption Spectra and the Nature of Dilute Solutions of Alkali Metals in Fused Alkali Halides ; Spectrophotometric Studies of Solute Species in Molten Fluoride Media; Advances in the Infrared Spectroscopy of Molten Salts; A Review of Raman Spectroscopy of Fused Salts and Studies of Some Halide-Containing Systems; The Investigation of Fused Salts by the Inelastic Scattering of Cold Neutrons; Transport Processes in Low-Melting Molten Salt Systems; Transport Properties: Conductivity, Viscosity, and Ultrasonic Relaxation; Electronic Conduction in Fused Salts; Electrical Conductivity Measurements in Molten Fluoride Mixtures, and Some General Considerations on Frequency Dispersion; The Distribution of Metals between Molten Fluorides and Liquid Metals; Investigation of the Capacity of the Electrical Double Layer in Molten Chlorides Using a Dropping Metal Electrode; Solutions of Halogens in Molten Halides; Electrode Reactions in Molten Fluorides; Voltammetric Studies of Chromium (II) in Molten LiF-BeF_2-ZrF_4 at 500° C.; and Thermochemistry, Complexation, Electron and Oxygen Transfer in Fused Nitrates.

The book will be of interest to research workers in molten salts, as well as to those in related areas such as metallurgy, glass technology, and solid state science. It will also be found useful by those interested in other non-aqueous solutions. C. V. R.

Indian Ephemeris and Nautical Almanac—1970. (Manager of Publications, Civil Lines, Delhi-6), Pp. xxii + 466. Price Inland Rs. 14·00; Foreign 32 *sh.* 8 *d.*; or $ 5.04.

This annual publication which was started in 1957 is the thirteenth of its kind, and is for the year 1970. The utility of the Indian Ephemeris is well known, especially in the field of the preparation of *Panchangas* in various parts of the country. The calculations of the Indian calendar portion are given in Indian Standard Time, and the calendar covers an extended period upto March 21, 1971 to meet the requirements of the makers of *Panchangas* for the *Saka era* 1892. A. S. G.

Award of Research Degrees

Karnatak University, Dharwar, has awarded the Ph.D. degree in Chemistry to Shri M. A. Pujar and Shri C. D. Doulatabad, Ph.D. degree in Zoology to (Miss) Malathi E. A. D'Souza.

The M.S. University of Baroda has awarded the Ph.D. degree in Physiology to Shri Shiva Datta Nishith, and Ph.D. in Physics to Shri P. P. Mathews.

Sri Venkateswara University has awarded the Ph.D. degree in Physics to Shri K. Raghunath; Ph.D. degree in Botany to Shri K. V. R. Ramana; Ph.D. degree in Zoology to Shri P. Sanjeeva Reddy; Ph.D. degree in Geology to Shri J. Jagannatha Rao.

Utkal University has awarded the Ph.D. degree in Physics to Shri P. Misra; Ph.D. degree in Botany to Shri P. A. Khan.

Books Received

Handbook of Neurochemistry (Vol. 2)—*Structural Neurochemistry*. Edited by Abel Lajtra. (Plenum Publication Corporation, 227, West 17th Street, New York 10011 U.S.A.), 1969. Pp. xxix + 579. Price $ 35.00.

Luminescence of Biopolymers and Cells. By G. M. Baren Boim, A. N. Domanskii and K. K. Turoverov. (Plenum Publication Corporation, 227, West 17th Street, New York 10011, U.S.A.), 1969. Pp. viii + 229. Price $ 12.50.

Axenic Mammalian Cell Reactions. Edited by G. L. Tritsch. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), Pp. xii + 413. Price $ 18.75.

Chemical Evolution—Molecular Evolution Towards the Origin of Living System on the Earth and Elsewhere. By Melvin Calvin. (Oxford University Press, Mount Road, Madras-6), Pp. ix + 278. Price 25 *sh.* or Rs. 22·50.

Fundamentals of Electrodynamics. By Boris Podolsky and K. S. Kunz. (Marcel Dekker, Inc., 95, Madison Avenue, New York, 10016), 1969. Pp. xiii + 492. Price $ 14.50.

The Indian Ephemeris and Nautical Almanac for the Year 1970. (The Director, Regional Meteorological Centre, Nautical Almanac Unit, Alipore, Calcutta), 1969. Pp. xxii + 466. Price Rs. 14·00, 32 *sh.* 8 *d.*, $ 5.4.

Vanaspatika Anusandhana Darsika. By K. C. Chunekar. (The Croukhamba Vidyabhawan, Post Box No. 8, Varanasi-1), Pp. 162. Price Rs. 10·00.

Developments in Applied Spectroscopy (Vol. 7 A). Edited by E. L. Grove and A. J. Perkins. (Plenum Publication Corporation, 227, West 17th St., New York 10011), 1969. Pp. ix + 341. Price $ 15.00.

1877-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

Phone : 572305 Grams : 'TEMPOVEN, SZ

Precision stabilized

THERMISTORS

Now manufactured in India by

TEMPO INDUSTRIAL CORPORATION

18-C, Paranjape 'B' Scheme,
Subhasha Road, Vile Parle (East),
BOMBAY 57 AS.

Types available :

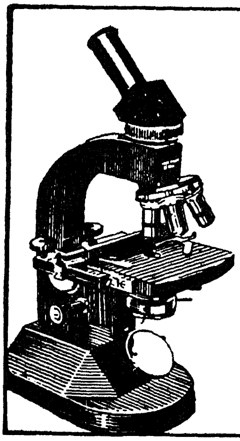
BEADS	PROBES
* MICRO BEADS	* GLASS PROBES
* BARE BEADS	* STAINLESS STEEL PROBES
* EPOXY COATED BEADS	* TEFLON PROBES

Disc Thermistors for Transistor Radios &

CERAMIC MAGNET.

IRL

OPTICAL INSTRUMENTS



microscopes
students' • laboratory
research • metallurgical
dissecting • travelling

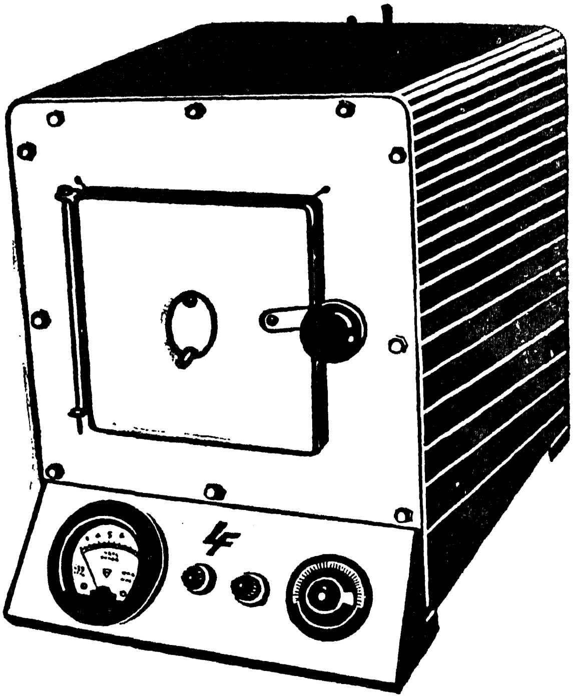
microscope attachments

spectrometer

telescope

GHARPURE & CO.

P-36 India Exchange Place Extension, Calcutta-1
Gram : MEENAMO • Phone : 22-2061



ELECTRICAL MUFFLE FURNACE

Special Features :

* Light in weight
* Easy to operate
* Temperature range guaranteed

Available in different sizes for various temperature ranges

Contact :

Laboratory Furnishers
DHUN MANSION, VINCENT ROAD
BOMBAY-14
TEL. : 442761 GRAM. : "LABFURNISH"
Branch Office :
KAPASIA BAZAR, AHMEDABAD-2

CHEMISTRY OF SHELF SEDIMENTS ON THE WEST COAST OF INDIA *

S. S. GOGATE, V. N. SASTRY, T. M. KRISHNAMOORTHY AND R. VISWANATHAN

Health Physics Division, Bhabha Atomic Research Centre, Bombay

INTRODUCTION

IN November-December 1964, an Expedition to Angria Bank in the Arabian Sea was jointly undertaken by the Department of Fisheries, Maharashtra, and Bhabha Atomic Research Centre. The Bank, which is of considerable importance to the commercial fisheries, is situated outside the continental shelf off Ratnagiri (Lat. 16° 59′ N, Long. 73° 16′ E). Data on sea-water characteristics (*viz.*, salinity, temperature, phosphate content, etc.) in the region have been reported by Vijayakrishnan Nair *et al.*[1] The present paper deals with the elemental and the adsorbed components of the sediments collected from the region during the expedition.

ANALYTICAL TECHNIQUES

Grab samples of the sediments were obtained from 13 stations between Bombay and Ratnagiri (Fig. 1). They were dried at 105° C.

Calcium carbonate was estimated from the difference between the loss of weight of sediment at 1,000° C and 400° C respectively. Organic matter was determined by oxidation with chromic acid and organic matter content was calculated using the conversion factor given by Walkley and Black.[3] This method is not affected by the presence of calcium carbonate and also able to discriminate between elemental carbon and soil organic matter, but is sensitive to the presence of chloride. The chloride content of the marine sediment was determined (leachable chloride obtained from 0·5 g sediment in contact with 100 ml distilled water for 24 hours) titrimetrically using silver nitrate. Higher contact time did not improve the leachable chloride value. Organic matter content was calculated after making suitable corrections for chloride interference.

5 gm of sediment was digested with 100 ml of concentrated hydrochloric acid for four hours. The solution was filtered, the residue along with the filter-paper was ashed, treated with a few ml of HF and taken up in conc. HCl. This was combined with the previous filtrate and the volume was made to 100 ml. Aliquots of this solution were taken for the estimations of major and trace elements in the sediments (total decomposition).

5 gm of sediment was ashed at 500° C and the sediment was extracted once with 3 N HCl. If the sediment contained more calcium carbonate additional quantity of 3 N HCl was added till all the calcium carbonate was dissolved. The solution was then filtered and the filtrate made to 100 ml with distilled water. This acid-soluble fraction of the sediment too was analysed for the same major and trace elements (3 N HCl leach).

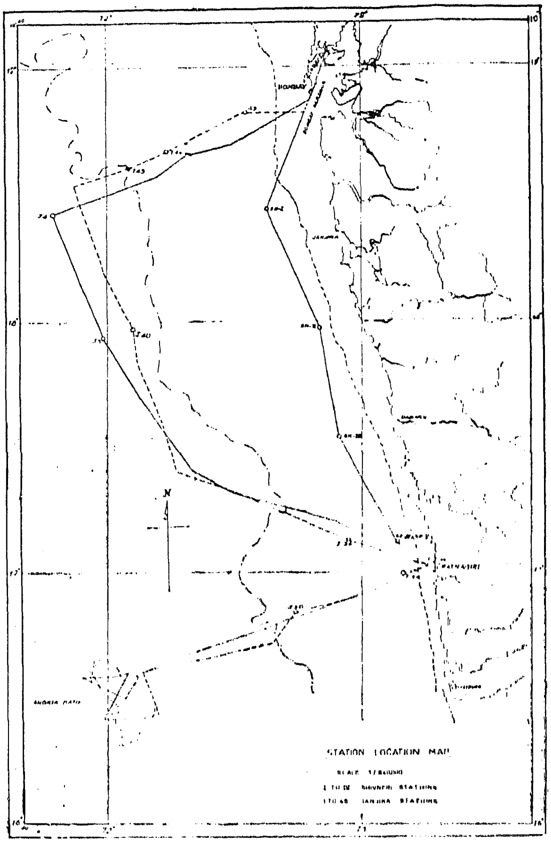


FIG. 1

Elemental concentrations in sediments obtained by total decomposition and the 3 N HCl leach respectively were compared in order to have an idea of the acid-soluble fraction of the sediments.[4]

Elemental concentrations were determined in these solutions as follows:

Potassium was precipitated as cobaltnitrite, dissolved in known volume of ceric sulphate and the excess ceric sulphate determined titrimetrically.[5] Calcium and magnesium were determined by titration with EDTA and magnesium solution.[5] For the estimation of iron, the colorimetric reaction with 2 : 2′ dipyridyl was employed.[6] Cobalt was determined spectrophotometrically by the nitroso-R-salt method.[6] Copper was estimated spectrophotometrically through its diethyldithiocarbamate complex.[6] Zinc was estimated spectrophotometrically in carbon tetrachloride extract of its dithizonate complex.[6] Manganese was oxidised with potassium periodate to permanganic acid and determined colorimetrically.[6] For the estimation of total phosphorus the acid extract was passed through an anion exchange resin (Dowex-1, 50-100 mesh) in 10 N HCl for removal of iron and the phosphate in the effluent was estimated through the molybdenum blue reaction.[7]

---

* This work is carried out under IAEA/BARC Research Agreement No. 155/R5/CF.

In case of chromium, 0·5 g of the sediment was fused with five times its weight of sodium and potassium carbonate (1 : 1) mixture. The fused mass was extracted with hot distilled water and filtered. The chromium content in the filtrate was estimated spectrophotometrically through its diphenylcarbazide complex.[6]

RESULTS AND DISCUSSION

Details of stations occupied off Bombay and Ratnagiri are given in Station Location Map (Fig. 1).

Data on the distribution of calcium carbonate and organic matter contents in sediments are given in Table I. Sediments near shore in general contain less calcium carbonate than those further offshore. An inverse relationship (correlation coefficient $r = -0 \cdot 80$) is apparent between calcium carbonate and decomposable organic matter (Fig. 2). This is understandable since the sediments nearer shore contain more organic matter due to land runoff.[8]

TABLE I

Organic matter and calcium carbonate contents of sediments

Sample	Lat. °N	Long. °E	Organic matter %	Calcium carbonate %
J4	1825	7147	0·21	92·3
J5	1756	7159	2·61	80·1
J30	1650	7244	1·54	71·2
J32	1650	7310	3·30	25·0
J34	1707	7257	4·54	38·7
J40	1758	7206	2·57	84·7
J43	1836	7205	1·55	79·9
J44	1840	7214	1·29	58·3
J45	1849	7233	1·91	31·1
SH1	1826	7237	2·04	34·7
SH3	1732	7255	2·34	79·3
SH4	1707	7308	4·46	28·7
*SH5	..	..	2·63	52·4

* Collected during the return cruise in the vicinity of SH4.

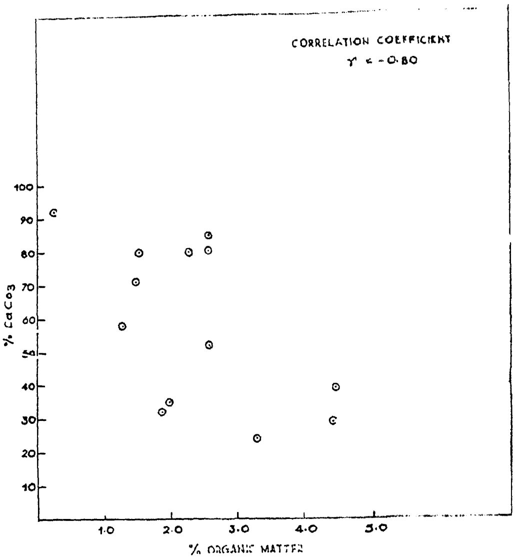


FIG. 2. Correlation of organic matter with calcium carbonate.

An inverse relationship (correlation coefficient $r = -0 \cdot 96$) between potassium and calcium carbonate is obtained suggesting that potassium is associated with the clay mineral, illite (Fig. 3). Welby[9] in his studies, in the Gulf of Mexico, found similar correlation between potassium and calcium carbonate.

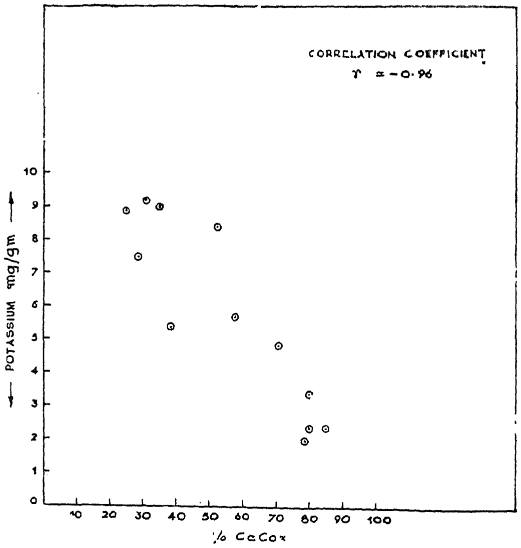


FIG. 3. Correlation of potassium with calcium carbonate.

Data on the elemental concentrations in sediments by the total decomposition and 3 N HCl leach are given in Tables II and III respectively. The contents of all the elements are higher by the total decomposition method. Only calcium was leached to the extent of 90-100% of the total by 3 N HCl. In the case of other elements like cobalt, zinc, manganese and phosphorus leach values constituted 40-80% of the total. These variations may be due to individual sample differences. Copper content was very high in total sediment and the leach constituted only 10-15% of the total. This indicates that copper is not associated with calcium carbonate phase.

TABLE II

Elemental concentration in sediments (Total decomposition)

Sample	K	Ca	Mg	Fe	Co	Cu	Zn	Mn	P	Cr
	mg/g				µg/g					
J-5	3·41	283	18·6	17·9	11·6	219	16·5	..	416	120
J-30	4·92	238	20·7	22·0	..	111	13·5	294	300	125
J-32	8·88	18	20·4	23·2	44·8	1372	14·5	450	364	221
J-34	5·40	..	25·0	23·2	28·8	250	24·0	294	416	265
J-40	2·40	313	24·0	15·3	9·2	64	12·0	110	448	119
J 43	2·40	289	..	20·8	9·6	125	7·0	..	404	79
J-44	5·70	202	16·7	22·4	21·2	535	..	500	304	121
J-45	9·20	28	21·2	24·0	46·0	390	23·5	654	376	695
SH-1	9·00	45	20·1	23·0	35·0	102	..	574	344	264
SH-3	2·00	329	7·9	14·6	11·6	81	7·0	204	300	57
SH-4	7·50	..	15·2	13·8	33·6	340	12·0	460	448	163
SH-5	8·40	193	17·6	14·5	19·6	282	17·5	584	323	214

TABLE III

Elemental concentration in sediments (3 N HCl leach)

Sample	K	Ca	Mg	Co	Cu	Zn	Mn	P
	mg/g			µg/g				
J 4	1·64	375	..	15·6	14·0	20·0	60	336
J-5	2·40	255	9·0	11·6	17·5	8·0	200	324
J-30	2·52	215	21·0	24·6	17·5	8·0	120	..
J-32	5·28	20	22·5	17·8	54·0	..	200	288
J-34	3·78	55	24·0	12·4	28·0	10·0	160	372
J-40	2·27	300	12·0	10·0	18·0	..	80	108
J-43	2·52	275	24·0	6·4	21·0	6·0	260	216
J 44	3·91	215	18·0	17·8	29·6	21·0	220	252
J-45	..	28	18·6	12·4	52·5	17·0	4[illegible]0	216
SH-1	4·28	48	15·0	17·2	48·0	22·0	470	96
SH-3	1·76	300	..	11·6	17·5	2·0	160	..
SH-4	3·53	40	15·0	10·0	40·0	16·0	..	276
SH-5	3·66	165	6·0	9·2	18·0	16·0	460	228

Table IV gives the differences in the elemental concentration of sediments off Bombay and Ratnagiri. Sample Nos. J-4, J-5, J-40, J-43 and J-44 are from the area 'B' nearer Bombay and the sample Nos. J-30, J-32, J-34, SH-4 and SH-5 are from area 'R' nearer Ratnagiri. Sediments in 'B' contain more calcium carbonate and calcium than sediments in 'R', but their content of organic matter is low. From the contour diagrams of Schott and Von Stackelberg,[10] it is seen that the sediments in area 'B' are predominantly chalky. Further south, nearer 'R' sediments show high content of potassium suggesting the presence of clay mineral illite as a dominant constituent in them. This clay mineral illite in this region constitutes 40-60% of the sediment particles less than 0·001 mm diameter.[11] Choudhuri and Banerji[12] confirmed by X-ray diffraction and differential thermal analyses that some of the samples J-32, J-45, SH-1 and SH-4 are clayey in nature with the major phase identified as illite. This clay mineral fraction of the sediment adsorbs trace elements from sea-water to a good extent.[13,14] Sediments showing high potassium values show markedly higher values of manganese, chromium, cobalt, zinc and copper (Table IV) while sediments containing low potassium values show significantly lower values of these trace elements. The over-all picture of the scatter diagram (Fig. 4) suggests that these trace elements are associated with potassium containing clay mineral rather than in the calcium carbonate phase. Chromium and manganese in particular showed good correlation with the samples having high potassium containing clay mineral illite as observed by Froehlich[15] and Hirst.[16]

TABLE IV

Differences in chemical composition of sediments off Bombay and Ratnagiri

No.	Elements	Units	'B'		'R'	
			Total	Leach	Total	Leach
1	K	mg/g	3·4	2·6	8·1	3·8
2	Ca	mg/g	272	263	103	84
3	Mg	mg/g	19·9	15·7	19·6	17·7
4	Co	µg/g	13·0	12·3	32·0	14·8
5	Cu	µg/g	236	20·0	431	31·8
6	Zn	µg/g	11·8	11·6	17·4	12·5
7	Mn	µg/g	305	190	417	337
8	P	µg/g	393	225	371	291
9	Fe	mg/g	19·1	..	19·3	..
10	Cr	µg/g	100	..	198	..
11	Organic matter	%	1·65	..	3·29	..
12	Calcium carbonate	%	79·1	..	43·2	..

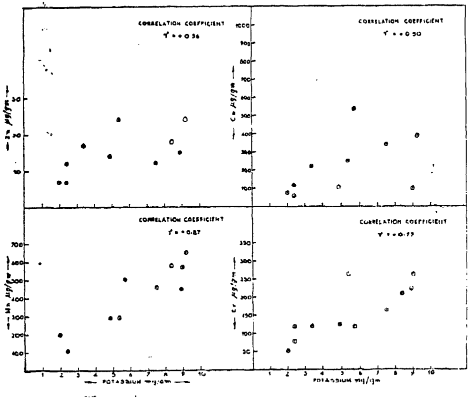


FIG. 4. Association of trace elements with potassium.

ACKNOWLEDGEMENTS

Our thanks are due to Dr. A. K. Ganguly, Head, Health Physics Division, Bhabha Atomic Research Centre, for his guidance and advice during the course of this work.

The active assistance of Shri M. Ramma Rao in some experimental work is gratefully acknowledged.

We are indebted to the scientists and crew of the Expedition vessels 'Janjira' and 'Shivneri' of Maharashtra State Fisheries for providing us with the sediment samples.

---

1. Vijayakrishnan Nair, K., Bhattathiri, P. M. A. and Chhapgar, B. F., "Angria Bank Expedition, 1, General Hydrographic and Chemical features. *AEET/HP/PM*—3, Bombay, 1965.
2. Thomson, T. G and Chow, T. J., " The Sr/Ca atom ratio in carbonate secreting marine organisms," *Deep Sea Research*, Suppl., 1955, **3**, 20.
3. Walkley, A. and Black, T. A., In *Soil Chemical Analysis*, Edited by Jackson, M. L., Prentice Hall, Indian Edition, 1962.
4. Barnes, H., *Apparatus and Methods of Oceanography Part I, Chemical*, George Allen and Unwin Ltd., London, 1959.
5. Vogel, A. L., *A Text-Book of Quantitative Inorganic Analysis—Theory and Practice*, Longman, London, 1951.
6. Sandell, E. B., *Colorimetric Determination of Traces of Metals*, 3rd Edition, Interscience Publishers, New York, 1959.
7. Hansen, A. L. and Robinson, R. J., *Journal Marine Research*, 1953, **12**, 16.
8. Sverdrup, H. U., Johnson, M. W. and Fleming, R. H., *The Ocean*, Prentice Hall, Inc., New York, 1942.
9. Welby, C. W., *J. Sediment Petro.*, 1958, **28**, 431.
10. Schott, W. and Von Stackleberg, U., " Recent sedimentation in the Indian Ocean ; its significance for the origin of hydrocarbonaceous sediments (First Review)," Paper No. 254 in Vol. IV of *Collected Reprints of International Indian Ocean Expedition*, UNESCO, Paris, 1965.
11. Gorbunova, Z. N., " Distribution of clay minerals in the sediments of the Indian Ocean," Paper No. 251 in Vol. IV of *Collected Reprints of Indian Ocean Expedition*, UNESCO, Paris, 1966.
12. Choudhuri, R. and Banerji, K C., "Some studies on Shelf Sediments from the Western Coast of Bombay and Ratnagiri," *Technology*, 1968, **5** (3).
13. Chester, R., "Elemental geochemistry of marine sediments." in *Chemical Oceanography*, Edited by Riley, J. P. and Skirrow, C., Academic Press. London and New York 1965, Vol. **2**.
14. Krauskopf, K. B., *Geochim. et Cosmochim. Acta*, 1956, **9**, **1**.
15. Frohlich, F., *Ibid.*, 1960, **20**, **215**.
16. Hirst, D. M., *Ibid.*, 1962 *b*, **26**, 1187.

TOTIPOTENCY OF GAMETIC CELLS AND THE PRODUCTION OF HAPLOIDS IN RICE

SIPRA GUHA,* R. D. IYER, N. GUPTA AND M. S. SWAMINATHAN

Indian Agricultural Research Institute, New Delhi-12

IT has long been realized that if male or female gametes could be stimulated to grow into embryos and give rise to haploid plants, it would greatly facilitate the task of obtaining pure lines by doubling the chromosome complement of the haploid with colchicine. Moreover, haploids also offer possibilities for inducing mutations and realizing them in a homozygous state, and for investigating various cytological problems. It has not, however, been easy to get haploids whenever required, although various techniques like distant hybridization, delayed pollination, application of irradiated pollen, hormone treatment, temperature shock and the use of genetic markers, have been employed in several plants with varying degrees of success.[1]

---

* Present address : Department of Botany, University of Delhi, Delhi-7.

A new approach to the induction of haploidy was opened up when androgenic haploids were obtained in *Datura* from pollen by culturing the anthers on suitable media.[2] This technique has since been used effectively in rice[3] and several species of *Nicotiana*.[4-7] The present report is a summary of experiments on anther culture carried out in rice (*Oryza sativa* subsp. *indica*) at I.A.R.I.

Florets, containing anthers at uninucleate microspore stage, were collected from several varieties of rice. Buds were surface-sterilized for 1-2 minutes in a dilute solution of chlorox and subsequently washed repeatedly with sterile water. The anthers were excised under aseptic conditions in an inoculation cabin, and planted on sterile nutrient medium.

The medium was composed of the same salts as used by Blaydes[8] for soybean callus culture. Various growth adjuvants like indoleacetic acid (IAA), 2, 4-dichlorophenoxyacetic acid (2, 4-D), kinetin, yeast extract and coconut milk were added to this medium. The media were sterilized by autoclaving at 15 lb./sq. in. for 15 minutes and solidified with 0·8% agar, after adjusting the pH at 5·8. The cultures were maintained at 25° C ± 1° C, for the initial 3-4 weeks in dark and then under light from flucrescent tubes.

Anthers were planted at various stages of development. If planted on the day of anthesis, when the pollen grains are mature, most of the anthers burst open liberating the pollen grains which later gave rise to pollen tubes. The pollen showed no abnormal divisions. On the other hand, anthers containing uninucleate microspores responded well to the culture medium and the pollen grains developed into pollen embryoids. If planted at earlier stages, namely, at the time of tetrad formation or earlier, the pollen did not develop further *in vitro*. Therefore, the experiments were carried out only with anthers containing uninucleate pollen grains.

In the basal medium containing no growth adjuvants, the pollen shrivelled up and no further division took place. In the presence of coconut milk (15%) and yeast extract (1,000 ppm), these cells were stimulated to divide. The addition of 2 ppm each of IAA and 2, 4-D and 1 ppm kinetin further stimulated mitotic divisions and, therefore, this complex medium was employed for promoting active divisions inside the pollen.

Two to three weeks after planting, some pollen grains started enlarging to two to three times their initial volume. In another week, they showed divisions within the confines of the exine. Finally, the exine ruptured and a callus mass was liberated which resembled a globular embryo (Fig. 1, A). Soon the anther wall also split open and numerous embryoids could be detected inside the pollen sacs (Fig. 1 B). It appeared that during the initial stages of development, pollen embryoids may get attached to the wall of the anthers by a suspensor-like outgrowth. This attachment could be easily missed if anthers are squashed or subjected to even a slight pressure while cutting them open. However, after some time the embryoids got detached from the anther wall and grew independently (Fig. 1, C). They were transferred at this stage (Fig. 1, D) to a fresh medium devoid of auxin since without transfer they did not grow further. In the new medium, they resumed their growth and eventually gave rise to haploid seedlings (Fig. 1, E). Subcultures made on the parent medium, on the other hand, only produced an undifferentiated mass of fragile callus tissue capable of continuous growth.

Twenty rice varieties were examined for their potential for giving rise to androgenic haploids through the anther culture technique, and profound variations were observed. A strain of comparatively primitive rice from Assam collection has given the maximum response so far. It would be too premature to surmise that genotypic differences are involved in determining this trait and hence, the experiments are being repeated.

The totipotency of the somatic cell has been clearly demonstrated in plants.[9,10] The totipotency of the gametic cell also seems to be well established now and through further refinements in technique, it should be possible to use this method in breeding programmes designed for exploiting heterosis. This approach may be of particular value in perennial crops. Attempts are now in progress at I.A.R.I. to extend this method to the tea plant where the production of the homozygous lines would be of great significance since it is a highly heterozygous, self-incompatible and clonally propagated species.

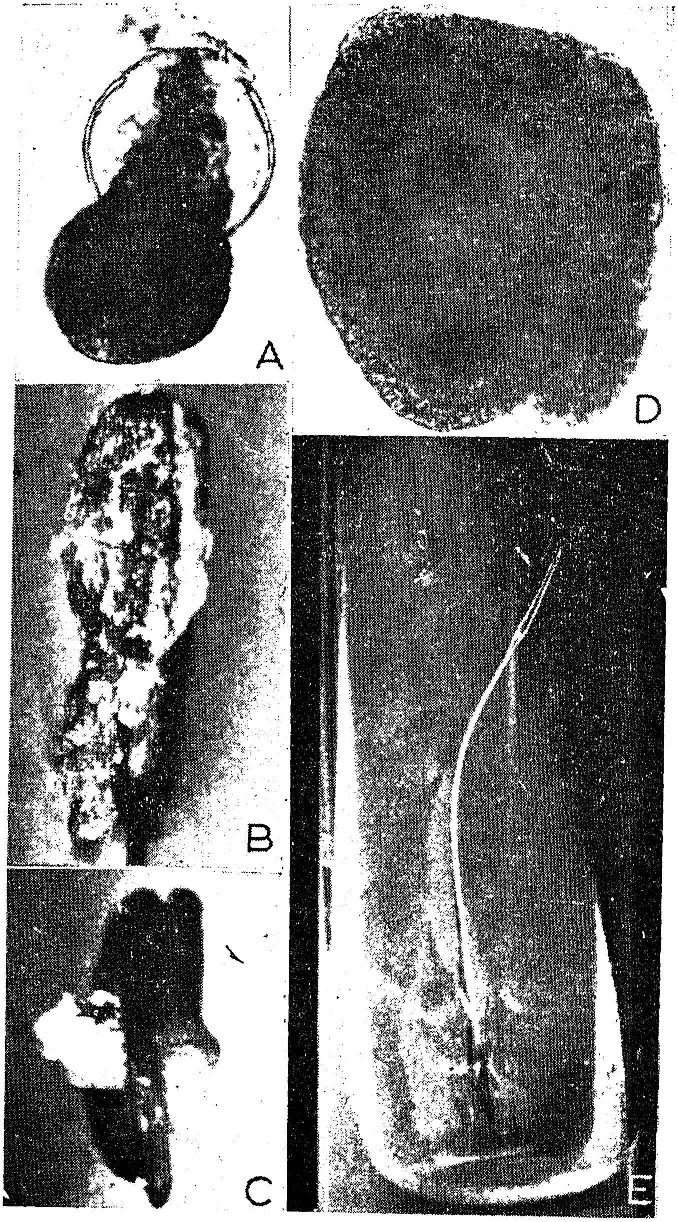


FIG. 1, A–E. A. A mass of cells emerging out of the broken exine 4–5 weeks after inoculation. B. Anther showing callusing of the pollen grains, arrow points to a developing globular embryo. C. Anther showing emerging out of an embryoid. D. A pollen embryoid, developing 4 weeks after inoculation. E. A plant developed from pollen embryoid.

The authors are grateful to Dr. E. A. Siddique for the supply of rice varieties, and to Mr. H. K. Gorkha for the photographs.

---

1. Kimber, G. and Riley, R., *Botan. Rev.*, 1963, **29**, 480.
2. Guha, Sipra and Maheshwari, S, C., *Nature*, 1964, **204**, 497.
   —, — and —, *Ibid.*, 1966, **212**, 97.
3. Niizeki, H. and Oono, K., *Proc. Japan Acad.*, 1968, **44**, 554.
4. Nakata, K. and Tanaka, M., *Japan J. Genet.*, 1968, **43**, 65.
5. Tanaka, M. and Nakata, K., *Ibid.*, 1969, **44**, 88.
6. Nitsch, J. P. and Nitsch. C., *Science*, 1969, **163**, 85.
7. Sunderland, N. and Wicks, F. M., *Nature*, 1969, **224**, 1227.
8. Blaydes, D. F., *Physiol. Plant.*, 1966, **19**, 748.
9. Steward, F. C., Mapes, Marion, O. and Mears, Kathryn, *Amer. J. Bot.*, 1958, **45**, 705.
10. Vasil, Vimla and Hildebrandt, A. C., *Science*, 1965, **150**, 889.

ENDOSPERM OF *TAXILLUS VESTITUS* WALL. : A SYSTEM TO STUDY THE EFFECT OF CYTOKININS *IN VITRO* IN SHOOT BUD FORMATION

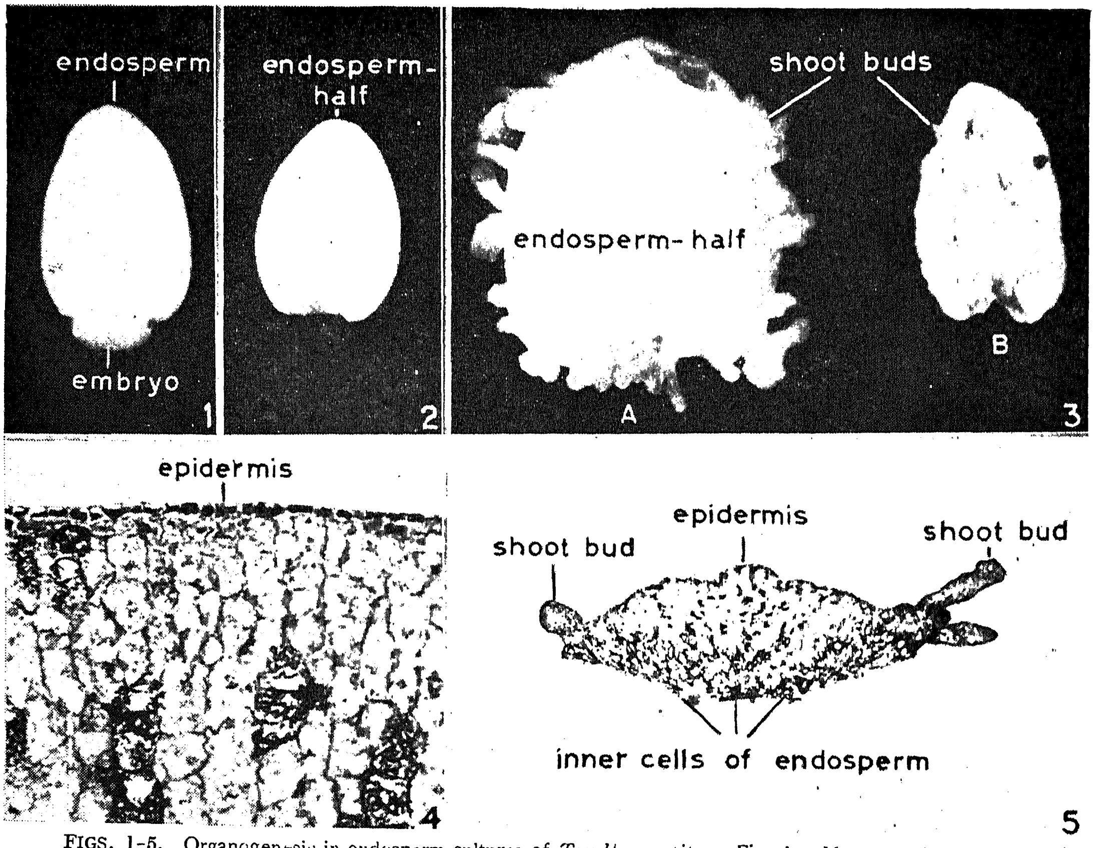
B. M. JOHRI AND K. K. NAG

Department of Botany, University of Delhi, Delhi-7 (India)

CYTOKININS promote the formation of shoot buds in many plant tissues cultured *in vitro*.[1] However, a few buds also develop in such cultures even in the absence of cytokinins, *i.e.*, in the controls.[2] In the present communication we report the regulation of the differentiation of shoot buds by cytokinins from the epidermal cells of mature endosperm of *Taxillus vestitus*. This tissue does not form shoot buds either under natural conditions, or in cultures in the absence of a cytokinin.

Ripe fruits of *T. vestitus* (Loranthaceæ) were washed with a detergent, surface sterilized with 90% ethyl alcohol, and the 'seeds' (endosperm + embryo ; there is no testa) (Fig. 1) excised aseptically. The mature endosperm (which encloses the embryo except at the radicular end) comprises about 20–22 layers of parenchymatous cells, containing starch or starch and tannin, surrounded by the small, densely cytoplasmic epidermal cells (Fig. 4). Like the endosperm of any other angiosperm, it lacks vascular elements.

The seed was cut longitudinally and after removing the embryo the endosperm-halves (Fig. 2) were implanted in two positions : cut



FIGS. 1-5. Organogenesis in endosperm cultures of *Taxillus vestitus*. Fig. 1. Mature endosperm (entire) with embryo intact, × 6·1. Fig. 2. Same cut longitudinally and embryo removed, showing only one endosperm-half with the cut surface exposed : stage of implantation, × 6·1. Fig. 3. 10-week-old culture of endosperm-half with cut surface in contact with the medium – WM + kinetin (10 ppm), there were as many as 18 shoot buds around the periphery, (A); only 2 small buds developed in the endosperm-half with cut surface away from the medium (on the epidermal side, B), × 11·4. Fig. 4. A portion of endosperm in section showing epidermis and inner cells ; stage of implantation, × 100·9. Fig. 5. Transection of an endosperm-half as in Fig. 3A, showing shoot buds developed on the periphery, × 14·6.

surface in direct contact with the nutrient medium, and cut surface away from the medium. The seed was also cut transversely into 3 or 4 pieces and only the pieces of endosperm were implanted with one of the cut surfaces in contact with the medium. Modified [without indoleacetic acid (IAA)] White's agar (0·8%) medium[3] containing 2·0% sucrose (WM) served as the control. Supplements used either individually or in different combinations included IAA, indolebutyric acid (IBA), naphthaleneacetic acid (NAA), 2, 4-dichlorophenoxyacetic acid (2, 4-D), 2, 4, 5-trichlorophenoxyacetic acid (2, 4, 5-T), adenine, and some substituted aminopurines : 6-benzylaminopurine, 6-benzylamino-9-(2-tetrahydropyranyl)-purine, 3-(γ, γ-dimethylallylamino)-purine, 6-(γ, γ-dimethylallylamino)-purine, 6-furfurylaminopurine (kinetin), 6-furfurylamino-8-azapurine, 6-isoamylaminopurine, and 6-methylaminopurine. For each treatment 24 cultures were maintained at 25 ± 3° C and 55 ± 5% relative humidity under diffuse daylight (10–15 ft-c). Each experiment was repeated thrice.

On WM alone, the endosperm proliferated only slightly at the cut end and the callus was highly ephemeral. Callusing was somewhat better on WM containing an auxin (2×10^{-5} M): IAA, IBA, NAA, 2, 4-D or 2,4,5-T. However, none of these media induced the formation of shoot buds.

When longitudinally or transversely cut pieces of endosperm were grown on WM supplemented with a cytokinin, after 3 to 4 weeks shoot buds developed along the cut surfaces in contact with the medium (Fig. 3 A). Anatomical studies showed that repeated division of epidermal cells, near the injured portion, was followed by the differentiation of buds and vascular tissues (Fig. 5, later stage). Cytological preparations of the developing shoot buds showed a normal triploid condition ($3n = 27$). The position of the explant on the medium had a remarkable influence on the differentiation of buds. Endosperm pieces with the cut surface in contact with the medium enlarged appreciably and produced as many as 13 shoot buds, while only 2 buds developed when the cut surface was away from the medium and the growth of explant remained arrested (Fig. 3 A, B).

The period required for the initiation of shoot buds, number of buds produced on each explant, and shape and size of buds varied from cytokinin to cytokinin and its concentration. At 10 p.p.m. of kinetin cent per cent cultures showed shoot buds after 6 weeks, while at 5 p.p.m. 9 weeks were required. There was practically no response with adenine, 3-(γ, γ-dimethylallylamino)-purine and 6-methylaminopurine ; with 6-benzylamino-9-(2-tetrahydropyranyl)-purine irregular swellings (not well-organized shoot buds) were noticed along the cut surface ; but progressive response was observed in inducing shoot buds with 6-furfurylamino-8-azapurine, 6-isoamylaminopurine, 6-furfurylaminopurine, 6-benzylaminopurine and 6-(γ, γ-dimethylallylamino)-purine (Fig. 7).

Injury to the explant resulted in the promotion of shoot bud differentiation on media containing cytokinins. Majority of shoot buds were confined to the injured portions which were in direct contact with the medium ; a few shoot buds were also formed around the injured surface even if they were not in direct contact with the medium. However, injury alone did not replace the effect of a cytokinin.

When the entire endosperm with the enclosed embryo was implanted, bud initiation was delayed by about 5 weeks, and the number of cultures showing shoot buds also diminished (by about 60% at 10 p.p.m. of kinetin ; Fig. 6). Furthermore, there were only about 3 buds per culture in contrast to 13 when only endosperm-half was cultured.

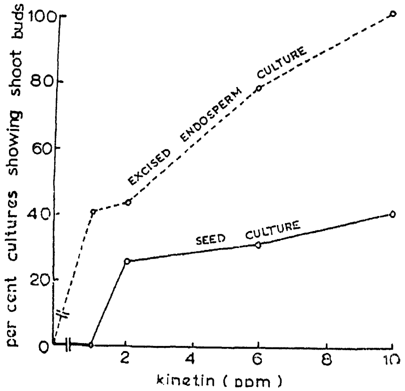


FIG. 6. Effect of kinetin on shoot bud formation from mature endosperm. Curve with dotted line represents the percentage of cultures with shoot buds in 6-week-old cultures, endosperm-half was implanted with the cut surface in contact with the medium ; solid line represents the shoot buds differentiated 9 weeks after culturing the entire endosperm with embryo intact.

Addition of an auxin to WM containing a cytokinin had an inhibitory effect on bud formation : NAA, 2, 4-D and 2, 4, 5-T (2×10^{-5} M) inhibited bud formation completely; IBA and IAA reduced the number of cultures showing shoot buds as well as the number of buds developing on each explant. In this species we have succeeded in chemically controlling the formation of shoot and haustorium from endosperm (to be published later).

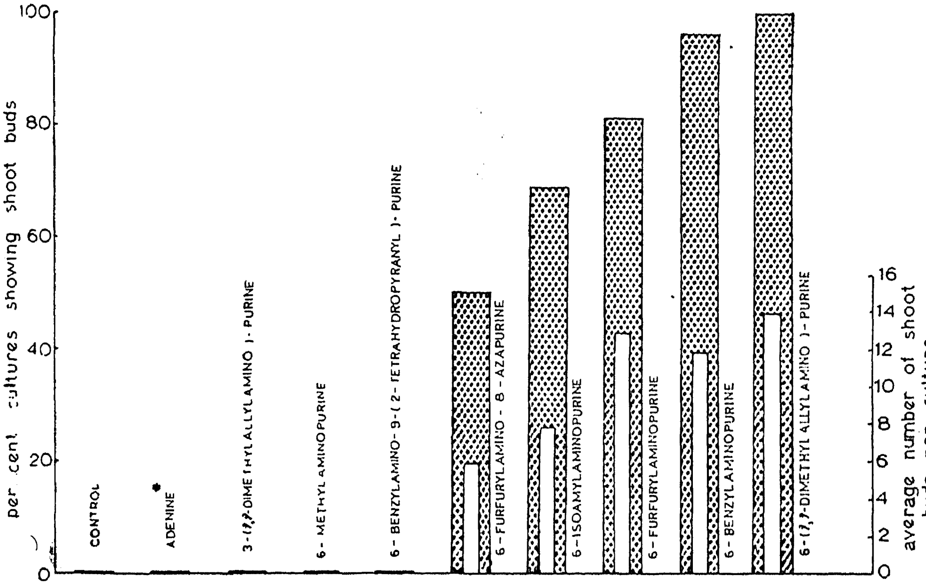


FIG. 7. Effect of some substituted aminopurines (and adenine*) at 2×10^{-5}M on shoot bud formation from endosperm-half implanted with cut surface in contact with the medium, in 8-week-old cultures.

Epidermal cells of some angiosperms, both *in vivo* and *in vitro*, have been reported to form buds,[4] and embryoids.[5,6] In these instances attention has not been drawn either to the specific sites of bud formation, or to a specific chemical leading to this phenomenon. Cytokinins enhance the differentiation of shoot buds in a number of plant tissues cultured aseptically. Recently, Paulet (1965)[7] showed a spectacular enhancement of the buds in tobacco tissue culture (approximately 300 buds with 1 mg./1 of kinetin against 32 without kinetin in *Nicotiana suaveolens*). However, as mentioned by Miller (1961),[2] in all those tissues in which the cytokinins promoted the formation of shoot buds, a few buds also developed in the controls, *i.e.*, without the presence of exogenous cytokinins. As far as we know, the present findings in *T. vestitus* is the first report in which shoot buds do not differentiate in the controls, *i.e.*, in the absence of cytokinins.

Grateful thanks are acknowledged to Dr. A. S. Rao (Shillong), Miss Usha Kaul and Mr. S. Chandra (University of Delhi) for providing the fruits of *T. vestitus*, to Dr. N. J. Leonard (Illinois) for kindly supplying some substituted aminopurines, and to Dr. M. M. Johri, Dr. S. S. Bhojwani and Mr. P. S. Srivastava for valuable suggestions. One of us (K. K. N.) is thankful to the University Grants Commission, New Delhi, for the award of a research fellowship, and to the University of Ranchi (Bihar) for granting study-leave.

---

1. Sahai Srivastava, B. I., *Int. Rev. Cytol.*, 1967, **22**, **349**.
2. Miller, C. O., *Ann. Rev. Plant Physiol.*, 1961, **12**, 395.
3. Rangaswamy, N. S., *Phytomorphology*, **1961**, **11**, 109
4. Crooks, D. M., *Bot. Gaz.*, 1933, **95**, 209.
5. Konar, R. N. and Nataraja, K., *Phytomorphology*, 1965, **15**, 132.
6. Kato, H., *Sci. Pap. Col. Gen. Ed. Univ. Tokyo*, **1968**, **18**, **191**.
7. Paulet, P., *Rev. Gen. Bot.*, **1965**, **72**, **697**.

LETTERS TO THE EDITOR

A NEW TYPE OF ANISOTROPIC COSMOLOGICAL MODEL WITH STRESS

STUDIES of anisotropic cosmological models of the universe are of interest today. Jacobs[1] has considered one such case. He takes a metric of the form

$$ds^2 = -A dx^2 - B dy^2 - C dz^2 + dt^2 \qquad (1)$$

with A, B, C as functions of time t satisfying field equations of the form

$$R_{ij} - \tfrac{1}{2} R g_{ij} = -8\pi T_{ij}. \qquad (2)$$

As far as we know, no anisotropic solution of

$$R_{ij} = \lambda g_{ij} \qquad (3)$$

where $g_{ij} = g_{ij}(t)$ is known. We have found an anisotropic solution of (3) to be

$$ds^2 = dt^2 - \left(\frac{Z+1}{\sqrt{Z}}\right)^{4/3} \left[\left(\frac{Z-1}{Z+1}\right)^p (dx^1)^2 + \left(\frac{Z-1}{Z+1}\right)^q (dx^2)^2 + \left(\frac{Z-1}{Z+1}\right)^r (dx^3)^2\right], \qquad (4)$$

where $Z = \exp.(t-t_0)\sqrt{3}\,\lambda$ and p, q, r are constants satisfying the conditions

$$\left.\begin{array}{l} p + q + r = 2 \\ \text{and} \\ pq + qr + rp = 0 \end{array}\right\}. \qquad (5)$$

t_0 is a constant of integration. The geodesic form of (4) makes it appropriate for cosmological studies.

For very large t, solution (4) approximates to de Sitter's universe in the form

$$ds^2 = dt^2 - \exp.\left(\sqrt{\frac{4\lambda}{3}}\, t\right) \times [(dx^1)^2 + (dx^2)^2 + (dx^3)^2]. \qquad (6)$$

Using the transformation

$$x^1 = (2)^{-2/3} \left(\frac{2k}{\sqrt{3\lambda}}\right)^{p/2} (X^1),$$

$$x^2 = (2)^{-2/2} \left(\frac{2k}{\sqrt{3\lambda}}\right)^{q/2} (X^2),$$

$$x^3 = (2)^{-2/3} \left(\frac{2k}{\sqrt{3\lambda}}\right)^{r/2} (X^3),$$

and then proceeding to the limit as $\lambda \to 0$, one finds that the form (4) reduces to

$$ds^2 = dt^2 - (1 + kt)^p (dx^1)^2 - (1 + kt)^q (dx^2)^2 - (1 + kt)^r (dx^3)^2, \qquad (7)$$

which is the curious solution of Narlikar and Karmarkar,[2] k being $-1/t_0$.

In the case of the curious solution $t_i^j = 0$, whereas for the metric (4), t_j^j is not zero as one would expect. For (4) the non-vanishing components of t_i^j are given by

$$16\pi t_1^1 = 16\pi t_2^2 = 16\pi t_3^3 = 4\lambda\sqrt{-g} = 4\lambda\left(Z - \frac{1}{Z}\right) \qquad (8)$$

revealing curiously a spatial isotropy. t_4^4 is zero which is in accordance with our expectation because of the divergence equations,

$$\frac{\partial}{\partial x^j}\left(T_i^j \sqrt{-g} + t_i^j\right) = 0. \qquad (9)$$

It is clear from (9) that if, in general, $g_{ij} = g_{ij}(t)$, (9) reduces to

$$\frac{\partial}{\partial t}\left(T_i^4 \sqrt{-g} + t_i^4\right) = 0$$

implying that

$$T_i^4 \sqrt{-g} + t_i^4 = \text{const.} \qquad (10)$$

However, I have learned from A. R. Prasanna[3] who has looked into this that

$$T_i^4 \sqrt{-g} + t_i^4 = 0, \qquad (11)$$

even in the more general case $[g_{ij}(t) \neq 0,\ i \neq j]$ than the one considered here.

The author wishes to place on record his sincere thanks to Prof. V. V. Narlikar, Lokamanya Tilak Professor of Applied Mathematics, University of Poona, for having suggested the problem and for his guidance throughout the preparation of this note. His thanks are due to his colleague R. S. Tikekar for checking the solution (4) independently and to the Council of Scientific and Industrial Research for the award of a Junior Research Fellowship which facilitated this work.

University of Poona, P. P. KALE.
Poona-7, *October* 1969.

---

1. Jacobs, K. C., *Astrophys. J.*, 1968, **153**, 661.
2. Narlikar, V. V. and Karmarkar, K. R., *Curr. Sci.*, **1946**, **15**, **69**.
3. Prasanna, A. R., *Ph.D. Thesis*, Poona University (unpublished).

O-H…S BONDS IN $Na_2S_2O_3$, $5H_2O$

SINGLE crystal neutron diffraction study of sodium thiosulphate pentahydrate has been reported recently by us.[1] With the integrated intensities of 390 reflexions, the structure was solved by conventional least squares method. The structure was found to be essentially the same as reported by Taylor and Beevers[2] from X-ray study. However, atomic positions differ from those of X-ray work. The hydrogen atom positions also differ from those reported by El Saffar[3] from n.m.r. study. The bond distances and angles of the five water molecules, calculated from our atomic parameters are listed in Table I (the atoms are numbered as in X-ray and n.m.r. work).

TABLE I

O–H…X	O–H	H…X	O…X	Angle O–H…X	H–H	Angle H–O–H
$H_1 \ldots O_3$	0·98 Å (1·00)	1·76 Å	2·73 Å	171·0°		
O_4					1·63 Å	107·5°
$H_2 \ldots O_2$	0·98 (1·00)	1·97	2·94	173·0		
$H_3 \ldots O_8$	0·96 (0·98)	1·82	2·77	171·2		
O_5					1·57	106·2
$H_4 \ldots O_3$	0·95 (0·98)	1·90	2·81	162·6		
$H_5 \ldots O_4$	0·94 (0·97)	1·88	2·73	159·3		
O_6					1·56	107·6
$H_6 \ldots S_1$	0·92 (0·94)	2·52	3·30	143·2		
$H_7 \ldots S_1$	0·93 (0·95)	2·38	3·13	142·8		
O_7					1·51	108·2
$H_8 \ldots O_8$	0·93 (0·95)	1·88	2·79	166·5		
$H_9 \ldots O_2$	0·95 (0·96)	2·48	3·39	161·1		
O_8					1·65	109·8
$H_{10} \ldots S_1$	0·96 (0·98)	2·59	3·40	145·2		

(OH-distances given in brackets are corrected for thermal vibration assuming riding model. Standard deviation in bond distances 0·02 Å and in angles 1·2°.)

The distances of 0·93–0·98 Å and the angles 106·2°–109·8° found in the water molecules appear to be normal. The hydrogen bond scheme falls into four classes: (*a*) two strong water-thiosulphate oxygen hydrogen bonds O_4–$H_1 \ldots O_3$ (2·73 Å) and O_5–$H_3 \ldots O_3$ (2·77 Å), (*b*) two strong water-water hydrogen bonds O_6–$H_5 \ldots O_4$ (2·73 Å) and O_7–$H_8 \ldots O_8$ (2·79 Å) (*c*) three weak water-thiosulphate oxygen hydrogen bonds O_4–$H_2 \ldots O_2$ (2·94 Å) O_8–$H_9 \ldots O_2$ (3·39 Å) O_5–$H_4 \ldots O_3$ (2·81 Å) and (*d*) three water-sulphur hydrogen bonds. The O–H…S angles (142·8°–145·2°) show considerable deviation from linearity, which is not unusual. The H…S (2·38–2·59 Å) and O…S (3·13–3·40 Å) distances are within the limits of forming the O–H…S bonds. Recently, Muir[4] has reported a similar O–H…S bond in $Ba_2S_2O_3$, H_2O. These are the first cases of reporting O–H…S bonds in crystals by neutron diffraction methods.

Details of the paper will be published in due course.

Nuclear Physics Division, V. M. PADMANABHAN.
Bhabha Atomic Res. V. S. YADAVA.
Centre, Trombay,
Bombay-85, *January* 2, 1970.

---

1. Padmanabhan, V. M., Navarro, Q. O., Garcia, A., Karsono, L., Il Hwan Suh and Chien, L. S., *Eighth International Congress of Crystallography*, Stony Brook, New York, **1969**.
2. Tayler, P. G. and Beevers, C. A , *Acta Cryst.*, **1952**, **3**, **141**.
3. El Saffar, Z. M., *Ibid.*, **1968**, **24 B**, **1131**.
4. Muir, Lj., *Nature*, **1969**, **224**, **686**.

AMPEROMETRIC DETERMINATION OF URANIUM AS TELLURITE

IN the present study, a procedure has been developed for the estimation of U(VI) amperometrically using sodium tellurite as titrant. Uranium forms a pale lemon yellow insoluble tellurite and can be precipitated in ammonium chloride, ammonium nitrate buffer. Since both the elements yield polarographic waves in the above buffer, an advantage of this observation has been taken to evolve the present procedure.

Reagents and apparatus: Uranyl acetate (E. Merck's sample) was prepared and was standardised by the oximate method.[1] Ammonium chloride and ammonium nitrate of AnalaR quality were used for the preparation of the buffer solution. 0·1 M sodium tellurite was prepared and its tellurium content was determined by the classical method.[2]

TABLE I

Amperometric determination of uranium as tellurite

Expt. No.	Uranium Taken mgm.	Uranium Found mgm.	Difference mgm.
I	0·591	0·591	..
II	1·182	1·182	..
III	2·955	2·984	+0·029
IV	3·546	3·546	..
V	4·728	4·697	−0·031
VI	5·910	5·968	+0·058
VII	7·092	7·180	+0·088

Necessary polarographic data for tetravalent tellurium and uranium^{+6} in NH_4Cl NH_4NO_3 buffer were obtained with the Leeds and Northrup Electrochemograph Type E. The titrations were carried out at dropping mercury electrode with the Fischer electropode and the pH measurements were made with Beckman's zeromatic pH meter.

Titrations carried out over a wide range of pH showed that reproducible and accurate results were obtained over a pH range 4·0 to 4·3. It has been observed that addition of alcohol to the titration mixture enhances the accuracy of results and the presence of 5 to 10% alcohol yielded best results. In addition, for satisfactory values the supporting electrolyte concentration should be maintained between 0·1–0·4 M.

In the final procedure adopted, aliquots of uranyl acetate solution were taken in the titration cell and requisite amounts of ammonium chloride, ammonium nitrate buffer and ethanol were added so as to have an overall concentration of 0·1 M and 5% respectively. A potential of −1·0 V *vs.* S.C.E. was applied. Pure nitrogen was streamed into the solution before and after each addition of the titrant. The galvanometer reading was noted after each addition of an aliquot of sodium tellurite. The precipitate was allowed to settle down before the current reading was noted. The process was repeated till a sufficient excess of the tellurite had been added and at least five or six readings were taken before and after the equivalence point. A V-shaped curve is obtained when the current readings are plotted against the volume of titrant.

Titrations were carried out with different concentrations of uranium and the results are returned in Table I.

Our sincere thanks are due to Professor G. B. Singh for providing facilities and to the Ministry of Scientific Research and Cultural Affairs, Government of India, for financial assistance to one of us (V. S. R.).

Division of Analytical Chemistry,
Banaras Hindu University,
Varanasi-5, *July* 31, 1969.

G. S. DESHMUKH.
V. S. SANKARA RAO.

---

1. Vogel, A. I., *A Text-book of Quantitative Analysis*, 2nd Edn., Longmans Green & Co., London, 1955, p. 471.
2. Lenher, V. and Homberger, A. W., *J. Am. Chem. Soc.*. 1908, **30**, 387; Cf. *Z. anal. Chem.*, 1911, **50**, 576.

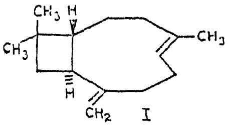
CARYOPHYLLENE EPOXIDE FROM THE OIL OF *ARTEMESIA SCOPARIA*, *ELSHOLTZIA POLYSTACHYA*, *PIPER HOOKERI* AND *PIPER BRACHYSTACHYUM*

THE components of the essential oil of *Artemesia scoparia* have been reported in a recent publication.[1] During the course of the investigation of this essential oil, a fraction distilling between 108–111°/7 mm. could not be easily characterised as it was a mixture of two components and was not easily resolvable. The mixture was repeatedly chromatographed over alumina columns and the fractions giving a sharp pink spot on TLC (vanillin-sulphuric acid spray) were combined. This fraction was further purified by preparative TLC (silica gel/NCL; 0·5 mm. thick plates) and repeated crystallisations from petroleum ether (40–60°) which gave colourless needles, m.p. 59–60° having Rf 0·30 (silica gel G, benzene). The same compound was also isolated from *Elsholtzia polystachya*, *Piper hookeri*, and *Piper brachystachyum*.

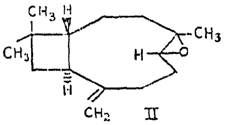
The high resolution mass spectroscopy* of this compound gave the molecular ion at 220·1797 thus establishing the molecular formula of $C_{15}H_{24}O$. The IR spectrum showed no hydroxy band suggesting the presence of oxygen either in the ether or an epoxide linkage. On acid hydrolysis it yielded a crystalline diol m.p. 146–148°.

Comparison of 100 MHZ NMR† spectrum of the known compound β-Caryophyllene[2] with that of our compound and the identical proton count (24 hydrogens) in the two compounds by the electronic integration of the various signals, occurring in their NMR spectra, show that the two compounds are essentially the same except that the double bond of the β-caryophyllene (I) has been replaced by the epoxide group in our compound thus giving it the structure (II).

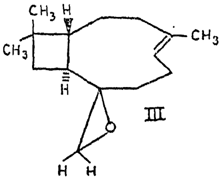
The resonances for the olefinic methyl group in the β-caryophyllene spectrum appears at $\delta = 1 \cdot 57^2$ whereas in the compound (II) it occurs at $\delta = 1 \cdot 205$. The upward shift of 0·365 p.p.m. for the methyl protons in the latter spectrum is attributed to the fact that the double bond present in the compound (I) has been replaced by the epoxide linkage in the compound (II).



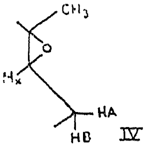
I



II



III



IV

From the biogenetic concept, it was also conceivable that the epoxide formation could have taken place at the terminal olefinic methylene group of β-caryophyllene thus giving rise to the compound (III) instead of compound (II). However, such a structural assignment to our compound is ruled out due to the fact that between $\delta = 2 \cdot 805$ and $2 \cdot 905$ appears a pair of doublets corresponding to one proton (the proton linked to the epoxide ring and adjacent to the oxygen atom). This pair of doublets arises due to the coupling of this hydrogen atom to the neighbouring two AB protons (IV). Furthermore at $\delta = 4 \cdot 93$ and $4 \cdot 99$ appear two vinyl proton resonances which are split into doublets having a geminal coupling constant of $J = 1 \cdot 25$ HZ. Such a coupling constant is consistent to the terminal olefinic methylene group.[3] Therefore, the structure (III) for our compound can safely be ruled out. Structure (II) is consistent with NMR data thus giving spectroscopic evidence of the structure of caryophyllene epoxide.

The structure of caryophyllene epoxide has been established before,[4] but no spectroscopic data has been presented so far in favour of its structure.

The authors are thankful to Dr. C. K. Atal, R.R.L. for initiating this work.

Regional Research Laboratory,
Jammu (Tawi), India,
and
Veterans Administration Hospital,
Dept. of Biochemistry, Univ. of Tennessee,
Memphis, Tennessee 38104,
R. K. Thappa.
V. N. Vashisht.
Jagdev Singh.
R. K. Sharma.

November 17, 1969.

---

* The mass spectral data were obtained on a Hitachi-Perkin-Elmer High Resolution Double Focussing RMU-6, Mass Spectrometer using a direct inlet probe.

† The NMR spectral data were obtained by running 5 to 6% solutions of the samples on an HA-100 NMR spectrometer which was directly linked to an IBM 1800 computer for spectral accumulation. TMS was used as the internal standard. Chemical shifts are quoted in p.p.m. (δ values).

1. Thappa, R. K., Vashist, V. N. and Atal, C. K., *Perf. Ess. Oil Rec.* (In press).
2. Corey, E. J., Mitra, R. B. and Uda, H., *J. Am. Chem. Soc.*, 1964, **86**, 485.
3. Bhacca, N. S. and Williams, D. H., *Application of NMR Spectroscopy in Organic Chemistry*, Holden-Day, Inc., San Francisco, 1966, p. 86.
4. Simonsen, J. and Barton, D. H. R., *The Terpenes*, The University Press, Oxford, 1952, **3**, 61.

BOSEIMYCIN—EFFECT OF pH ON ITS ANTIMICROBIAL ACTIVITY

In the earlier part of our investigation on the production and assay of the antibiotic boseimycin,[1] it was observed that the antimicrobial activity was dependent on the pH of the test medium. So an extensive study was needed to be carried out on this aspect with boseimycin sensitive micro-organisms. The results of this investigation are reported here.

Boseimycin, a broad spectrum antibiotic was isolated from an unidentified *Streptomyces* sp. Ac_6 569[1] as a water-soluble, strongly basic compound belonging to streptothricin group of antibiotics. The minimal inhibitory concentrations (MIC) of boseimycin was determined by standard tube dilution procedure in different pH of the test medium. Nutrient broth was used for the growth of bacteria (*Staphylococcus aureus* and *Escherichia coli*) and Sabouraud's medium for *Candida albicans*.

The MIC of boseimycin was found to be 2 μg./ml. at pH 8·0 against *C. albicans* but at pH 5·5 it was 150 μg./ml, (Table I). There was a seventy-five-fold decrease in MIC or in other words, a seventy-five-fold increase in activity was obtained with boseimycin, for a change in pH from 5·6 to 8·0. The pH sensitivity of boseimycin was also extended to gram positive and gram negative bacterial test organisms. Two laboratory strains of *S. aureus* and *E. coli* K_{12} were found to be growing well in this wide range of pH. As seen in Table I, boseimycin shows a marked increase in sensitivity towards *S. aureus* about fifty times whereas in *E. coli* K_{12} only a seven-fold increase in activity is exhibited with the pH changing from 5·5 to 8·0. The antibiotic was found to be the most effective antimicrobial agent against these test organisms at pH 8·0.

TABLE I

Minimal inhibitory concentrations of boseimycin (μg./ml.)

pH	*S. aureus*	*E. coli* K_{12}	*C. albicans*
5·5	50	15	150
6·0	25	15	75
6·5	25	10	30
7·0	10	5	10
7·5	3	2	5
8·0	1	2	2
8·5	3	2	3
9·0	3	2	20

The present-day interpretations[2] on the enhancement of antimicrobial activity of an antibiotic are based on (*a*) the degree of ionisation of the antibiotic at different pH making it more accessible to bacterial cell, (*b*) basic antibiotics competing with H-ions and acidic substances competing with OH-ions for a receptor site on bacterial cell wall, and (*c*) the activity changing with the change of pH on the bacterial receptors. These factors either alone or in combination seem to be responsible for the determination of the activity of an antibiotic at different pH. Streptomycin being a basic antibiotic exhibits a hundred-fold change in the activity for a pH change from 5·2 to 7·7. Penicillin[3] and Novobiocin[4] being acidic substances are found to be more active at acidic pH.

Boseimycin, being a strongly basic antibiotic with pK, 7·5, 8·35, 9·85 and > 11 (unpublished data), the enhancement of its antimicrobial activity at alkaline pH can be explained on the basis of its ionisation at particular pH making it more accessible to whole cells. The difference in sensitivity from one organism to another may be attributable to lipid contents of cell membranes which may play an important role in accepting or rejecting a particular compound under ionic influences. The lipid content of *E. coli* in cell membranes is much higher than that of *S. aureus* and *C. albicans*.[5] This appears to be one of the plausible factors for the difference in sensitivity of boseimycin against these organisms at different pH.

However, for a successful clinical use, the decreased activity of basic natured drugs in acidic pH against pathogenic organisms might cause a serious handicap. A study of the pH effect of a drug is always necessary in order to make it more effective at lower concentrations. This eliminates the introduction of additional amount of drugs which under certain conditions can lead to some harmful results.

The authors are grateful to Dr. P. N. Nandi, Head of the Department of Microbiology, for his constant help and encouragement.

Dept. of Microbiology, RAMRENU SANYAL.
Bose Institute, RABINDRA K. SINHA.
93/1, Acharya P.C. Road,
Calcutta-9, *November* 21, 1969.

---

1. Sinha, R. K. and Nandi, P. N., *Experientia*, 1968, **24**, 795.
2. Sabath, L. D., *Antimicro. Agents and Cheme*, 1967, p. 210.
3. Abraham, E. P. and Duthie, E. S., *Lancet*, 1946, **1**, 455.
4. Brock, T. D. and Brock, M. L., *Arch. Biochem. Biophy.*, 1959, **85**, 176.
5. Rogers, H. G. and Perkins, H. R., *Cell Walls and Membranes*, E. and F. N. Spon Ltd., London, 1968.

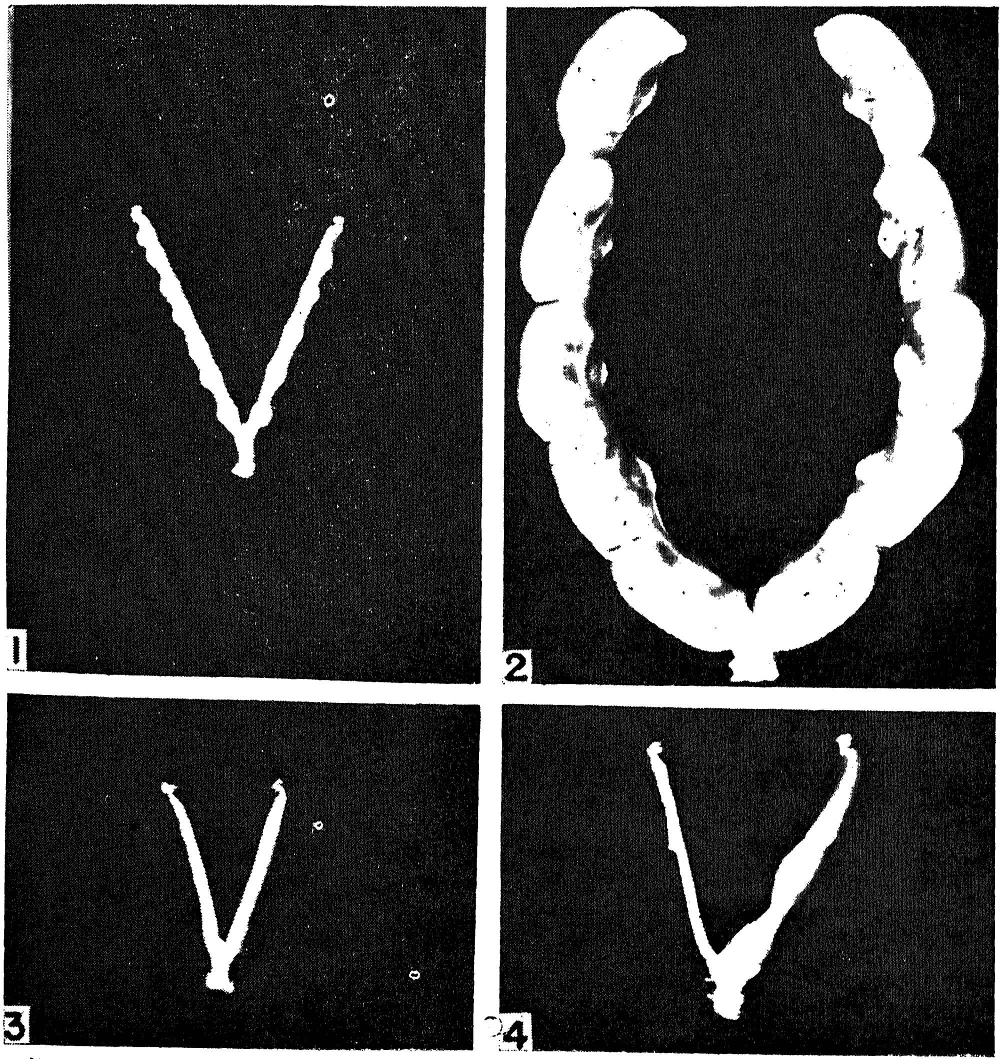
EFFECT OF METOPIRONE ON PREGNANCY IN ALBINO RATS

GRAVIMETRIC, histological and biochemical analyses indicate increased adrenal activity during pregnancy.[1-3] Adrenalectomy in the early part of pregnancy in the rat causes resorptions or abortions.[4] Administration of glucocorticoids maintains pregnancy to full term but not mineralocorticoids in adrenal ablated rats.[5] As Metopirone inhibits the synthesis of glucocorticoids and enhances the secretions of mineralocorticoids of adrenals,[6-8] it will be of interest to study its effect on pregnancy in albino rats.

Adult female albino rats (170 to 200 gm.) of Holtzman strain were mated with fertile males during proestrus. Rats, showing sperms in their vaginal smears on the following morning, were selected and that day was designated as day O of pregnancy. On the 8th day of pregnancy, they were laparotomized under ether anaesthesia to note the number of implantation sites. 9 mg. of Metopirone (Su-4885, Ciba) per 100 gm. body weight in 1 ml.

of 0·9% saline was administered subcutaneously twice a day from day 8 to 19 and autopsied on day 20 of pregnancy. The controls received 1 ml. of 0·9% saline per 100 gm. body weight twice a day for the same period. The rats were housed in individual cages at a room temperature of 27° ± 1° C, with the natural light of 13 hours and were fed with Hindustan Lever's rat feed with water *ad libitum*. Body weight and vaginal smear were recorded daily. The fœtuses, ovaries, uteri, adrenals and thymus were dissected, weighed to nearest mg., fixed in Bouin's fluid, sectioned at 10 μ thick and stained in Harris' hæmatoxylin-eosin.

The results indicate that out of six animals treated with Metopirone, three showed complete resorption of embryos at autopsy (Table I, Fig. 3). In these rats profuse bleeding was observed from day 11 to 14 of pregnancy. The remaining three Metopirone-treated rats showed partial resorptions with a few live embryos, still-borns, placentomas and placental scars (Fig. 4). In these rats there was profuse bleeding from day 15 to 18 of pregnancy. The saline-treated controls had normal pregnancy without any significant fœtal resorption, wherein the per cent fœtal survival was 95·74%, while in Metopirone-treated group it was only



FIGS. 1-4. Fig. 1. Uterus on day 8 of pregnancy showing implantation sites, × 0·58. Fig. 2 Uterus on day 20 of pregnancy showing fully developed fœtuses, (control), × 0· 58. Figs. 3 and 4 Uteri of Metopirone-treated pregnant rats on day 20 showing complete or partial resorptions with placentomas respectively, × 0·58.

TABLE I

Effect of metopirone on pregnancy in albino rats

	Number of rats				Mean in relation to pregnant rat at lapartomy M±S.E.				Organ weight/100 gm. body weight M±S.E.		
	Pregnant at		Showing resorption								
Treatment	Laparotomy	Autopsy	Complete	Partial	Implantations	Viable fœtuses	Fœtal survival (%)*	Foetal weight (gm.)	Uterus (gm.) without fœtuses	Ovaries (mg.)	Adrenals (mg.)
Controls ..	5	5 (100%)	..	..	9·40 ± 0·86	9·00 ±0·36	95·74	4·62 ±0·13	2·34 ±0·05	36·65 ± 0·75	21·87 ± 1·0
Metopirone	6	2 (33·33%)	3 (50%)	1 (16·67%)	10·00 ± 1·63	2·00 ±1·33	20·00	3·55 ±0·24	0·95 ±0·60	34·12 ± 0·72	37·3 ± 2·81

Numbers in parentheses denote percentage. M±S.E. = Arithmetic Mean ± Standard Error.

* Total number of fœtuses/Total number of implantations, ×100.

20% (Table I, Figs. 1, 2). There was no appreciable reduction in the ovarian weight in the drug-treated rats, but the fœtal weight was reduced. It is interesting to note that the adrenals were heavier in Metopirone-treated rats when compared to that of controls suggesting an increased output of ACTH.

Normal pregnancy requires an optimum quantity of circulating glucocorticoids and mineralocorticoids.[4,5,9] Metopirone is known to selectively inhibit the synthesis of glucocorticoids and increases the secretion of mineralocorticoids.[6-8] Therefore, the fœtal resorption or abortion observed in this experiment may be due to the inhibition of glucocorticoid secretion or increased titres of mineralocorticoids, specially desoxycorticosterone. This assumption corroborates the observations made by Cupps,[5] who has shown that desoxycorticosterone acetate alone is unable to maintain pregnancy in adrenalectomized rats.

We are highly indebted to ICMR, New Delhi, for financial assistance, to Ciba, India, for the supply of Metopirone, and to the Karnatak University for research facilities. Our thanks are due to Mr. P. R. Patil for photographs.

Dept. of Zoology, S. A. NEVAGI.
Karnatak University, M. APPASWAMY RAO.
Dharwar-3, India, *January* 25, 1970.

---

1. Venning, E. H., *Endocrinol.*, 1946, **39**, 203.
2. Beam, J. G., Gould, R. P. and Jones, H. E. H., *Acta Anat.*, 1960, **41**, 273.
3. Anderson, R. R. and Turner, C. W., *Endocrinol.*, 1962, **70**, 796.
4. Davis, M. E. and Plotz, E. J., *Ibid.*, 1954, **54**, 384.
5. Cupps, P. T., *Ibid.*, 1955, **57**, 1.
6. Gaunt, R., Steinetz, B. G. and Chart. J. J., *Clin. Pharmacol. and Therap.*, 1968, **9**, 957.
7. Liddle, G. W., Island, D. L., Edward, M. an Harris, A. P., *J. Clin. Endocri.*, 1958, **18**, 906.
8. Jenkins, J. S., Meakin, J. W., Nelson, D. H. an Thorn, G. W., *Science*, 1958, **128**, 478.
9. Robson, J. M. and Sharaf, A. A., *J. Physiol.*, 19 **116**, 236.

ON A RECORD LANDING OF POMFRETS IN THE INDIAN WATERS

Blue Fin, the Sweden built Fishery Trainin Vessel of the Central Institute of Fisheri Operatives, was on one of her regular trainin voyages from 19th to 21st November, 19 operating off Alleppey at a depth range 28–37 m. when she came across huge sho of pomfrets. Concentrating its programme the same area for 3 days the vessel caught 13,089 kg. of fish of which 9,774 kg. (74·7 was constituted by a single species, *Pamp argenteus* (Euphr.), the silver pomfret. Oth major categories of fish landed were shark and rays (14·9%), cat fish (4·5%) an carangids (2·7%). The gear operated wer a 25 fathom nylon trawl and a 110′ Swedi trawl and the otter boards were the Russian type oval boards each weighing 265 kg. T the best of our knowledge no fishing vessel in India has at any one time landed such a hug catch of pomfrets.

The trawler used in this operation is a stee built vessel of 28·5 m. overall length with 60 to 650 H.P. B and W Alfa main engine wit a cruising speed of 11 knots. The trawlin speed during this particular operation range from 2·75 to 3 knots.

The vessel made 18 hauls during the 3 day spending a total of 23 hrs. 15 mts. in actua trawling. The catch per trawling hour i 563 kg. for all fish and 420 kg. for the pomfret alone. The tenth haul of the voyage made on 20th November, between 10–20 and 11–50 a.m. brought in the maximum catch of 2,500 kg. of pomfrets, giving a catch rate of 1,667 kg. per hour for this species. The last haul of the voyage made between 3–00 and 4–30 p.m. the next day gave a catch rate of 1,167 kg. of pomfrets per hour. Although no published records on individual hauls are available, the catch rate of 1,667 kg. per hour for the species is perhaps the highest obtained in Indian waters.

The pomfrets landed are presumably of the same age group as the length frequency distribution of a random sample of 352 individuals would indicate.

Length group (Fork length in mm.)	Frequency %
161–170	0·6
171–180	1·4
181–190	10·2
191–200	39·5
201–210	35·2
211–220	9·3
221–230	2·6
231–240	0·6
241–250	0·6

The smallest fish in the sample measured 170 mm. and the largest 247 mm. Examination of the gonads of a subsample of 30 fish revealed that they were all immature being at stage II of maturity. Gopalan has found that *P. argenteus* has a prolonged spawning season extending from February to August with a probable intensive spawning during April to June.[1] The stomach contents were in a pulverised state, the food having been thoroughly 'milled'.

The average annual landings of marine fish in India are 869,650 tonnes, of which pomfrets are 22,115 tonnes constituting 2·54% of the total. Maharashtra and Gujarat are the leading pomfret-landing states with an annual average of 9,518 and 6,275 tonnes respectively. Pomfrets in the Kerala waters contribute only 942 tonnes which forms 0·28% of the total marine fish production of Kerala. (All figures relate to the averages of last five years, 1964–1968).[2]

Kerala coastal waters have been one of the most intensely trawled areas in India during the last about 10 years and pomfrets have been caught only in small quantities. It would appear that the shoals caught by *Blue Fin* had migrated from elsewhere. Though pomfrets are known as a migrating group no work has been done in India on this aspect.

The authors express their appreciation of the excellent team-work of Skipper K. Balan and his crew which made this catch of pomfrets possible.

Central Institute of
Fisheries Operatives,
Cochin-16, *November* 29, 1969.

M. C. PERUMAL.
K. ALAGARSWAMI.

---

1. Gopalan, U. K., *International Indian Ocean Expedition Newsletter*, 1967, **4** (4), Abstract.
2. Central Marine Fisheries Research Institute, *Bull. cent. mar. Fish. Res. Inst.*, 1969, No. 13.

BRACHYGNATHIA IN SHEEP AND ITS INHERITANCE

A CASE of short lower jaw in Chokla breed of sheep is reported. It was found to be associated with rudimentary tongue, absence of teeth and partial development of buccopharyngeal opening. The inheritance of the brachygnathia is suggested to be simple autosomal recessive.

Brachygnathia, overshot or parrot mouth in sheep, where the lower jaw appears too short in comparison to upper jaw, has been described by Rae (1962). From the genetic and economic point of view this condition is important since it is suspected of being inherited and results in lamb losses (Dennis, 1965). A case of brachygnathia has been observed and discussed in this paper.

An otherwise normal female lamb No. C 278 of Chokla breed weighing 3·75 kg. was born to a Chokla ewe No. C 14 on 18-9-1969, with an extremely short lower jaw (Fig. 1). The sire of the lamb was of Chokla breed (No. C 19). Neither the sire nor the dam of the lamb were scored for brachygnathia. The dam (C 14) had no abnormal lamb on previous lambings. During this lambing season C 19 has sired 9 lambs in addition to the one under consideration. None of the members of half-sib family

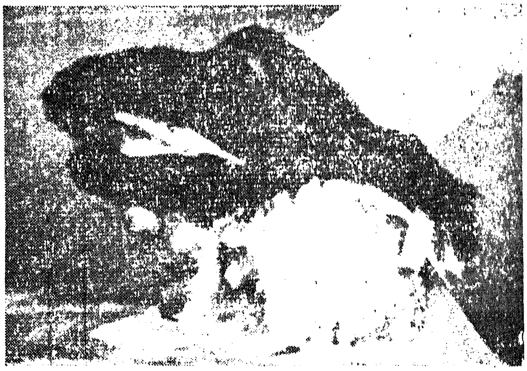


FIG. 1

TABLE I

Effect of metopirone on pregnancy in albino rats

Treatment	Number of rats				Mean in relation to pregnant rat at laparotomy M±S.E.				Organ weight/100 gm. body weight M±S.E.		
	Pregnant at		Showing resorption								
	Laparotomy	Autopsy	Complete	Partial	Implantations	Viable fœtuses	Fœtal survival (%)*	Foetal weight (gm.)	Uterus (gm.) without fœtuses	Ovaries (mg.)	Adrenals (mg.)
Controls ..	5	5 (100%)	..	..	9·40 ± 0·86	9·00 ±0·36	95·74	4·62 ±0·13	2·34 ±0·05	36·65 ± 0·75	21·87 ± 1·03
Metopirone	6	2 (33·33%)	3 (50%)	1 (16·67%)	10·00 ± 1·63	2·00 ±1·33	20·00	3·55 ±0·24	0·95 ±0·60	34·12 ± 0·72	37·36 ± 2·81

Numbers in parentheses denote percentage. M±S.E. = Arithmetic Mean ± Standard Error.

* Total number of fœtuses/Total number of implantations, ×100.

20% (Table I, Figs. 1, 2). There was no appreciable reduction in the ovarian weight in the drug-treated rats, but the fœtal weight was reduced. It is interesting to note that the adrenals were heavier in Metopirone-treated rats when compared to that of controls suggesting an increased output of ACTH.

Normal pregnancy requires an optimum quantity of circulating glucocorticoids and mineralocorticoids.[4,5,9] Metopirone is known to selectively inhibit the synthesis of glucocorticoids and increases the secretion of mineralocorticoids.[6-8] Therefore, the fœtal resorption or abortion observed in this experiment may be due to the inhibition of glucocorticoid secretion or increased titres of mineralocorticoids, specially desoxycorticosterone. This assumption corroborates the observations made by Cupps,[5] who has shown that desoxycorticosterone acetate alone is unable to maintain pregnancy in adrenalectomized rats.

We are highly indebted to ICMR, New Delhi, for financial assistance, to Ciba, India, for the supply of Metopirone, and to the Karnatak University for research facilities. Our thanks are due to Mr. P. R. Patil for photographs.

Dept. of Zoology, S. A. NEVAGI.
Karnatak University, M. APPASWAMY RAO.
Dharwar-3, India, *January* 25, 1970.

---

1. Venning, E. H., *Endocrinol.*, **1946, 39,** 203.
2. Bearn, J. G., Gould, R. P. and Jones, H. E. H., *Acta Anat.*, 1960, **41**, 273.
3. Anderson, R. R. and Turner, C. W., *Endocrinol.*, **1962, 70,** 796.
4. Davis, M. E. and Plotz, E. J., *Ibid.*, **1954, 54,** 384.
5. Cupps, P. T., *Ibid.*, 1955, **57,** 1.
6. Gaunt, R., Steinetz, B. G. and Chart, J. J., *Clin. Pharmacol. and Therap.*, 1968, **9,** 957.
7. Liddle, G. W., Island, D. L., Edward, M. and Harris, A. P., *J. Clin. Endocri.*, 1958, **18,** 906.
8. Jenkins, J. S., Meakin, J. W., Nelson, D. H. and Thorn, G. W., *Science*, 1958, **128,** 478.
9. Robson, J. M. and Sharaf, A. A., *J. Physiol.*, 1952, **116,** 236.

ON A RECORD LANDING OF POMFRETS IN THE INDIAN WATERS

Blue Fin, the Sweden built Fishery Training Vessel of the Central Institute of Fisheries Operatives, was on one of her regular training voyages from 19th to 21st November, 1969 operating off Alleppey at a depth range of 28–37 m. when she came across huge shoals of pomfrets. Concentrating its programme in the same area for 3 days the vessel caught 13,039 kg. of fish of which 9,774 kg. (74·7%) was constituted by a single species, *Pampus argenteus* (Euphr.), the silver pomfret. Other major categories of fish landed were sharks and rays (14·9%), cat fish (4·5%) and carangids (2·7%). The gear operated were a 25 fathom nylon traml and a 110′ Swedish trawl and the otter boards were the Russian type oval boards each weighing 265 kg. To the best of our knowledge no fishing vessel in India has at any one time landed such a huge catch of pomfrets.

The trawler used in this operation is a steel-built vessel of 28·5 m. overall length with 600 to 650 H.P. B and W Alfa main engine with a cruising speed of 11 knots. The trawling speed during this particular operation ranged from 2·75 to 3 knots.

The vessel made 18 hauls during the 3 days spending a total of 23 hrs. 15 mts. in actual trawling. The catch per trawling hour is 563 kg. for all fish and 420 kg. for the pomfrets alone. The tenth haul of the voyage made on 20th November, between 10–20 and 11–50 a.m. brought in the maximum catch of 2,500 kg. of pomfrets, giving a catch rate of 1,667 kg. per hour for this species. The last haul of the voyage made between 3–00 and 4–30 p.m. the next day gave a catch rate of 1,167 kg. of pomfrets per hour. Although no published records on individual hauls are available, the catch rate of 1,667 kg. per hour for the species is perhaps the highest obtained in Indian waters.

The pomfrets landed are presumably of the same age group as the length frequency distribution of a random sample of 352 individuals would indicate.

Length group (Fork length in mm.)	Frequency %
161–170	0·6
171–180	1·4
181–190	10·2
191–200	39·5
201–210	35·2
211–220	9·3
221–230	2·6
231–240	0·6
241–250	0·6

The smallest fish in the sample measured 170 mm. and the largest 247 mm. Examination of the gonads of a subsample of 30 fish revealed that they were all immature being at stage II of maturity. Gopalan has found that *P. argenteus* has a prolonged spawning season extending from February to August with a probable intensive spawning during April to June.[1] The stomach contents were in a pulverised state, the food having been thoroughly 'milled'.

The average annual landings of marine fish in India are 869,650 tonnes, of which pomfrets are 22,115 tonnes constituting 2·54% of the total. Maharashtra and Gujarat are the leading pomfret-landing states with an annual average of 9,518 and 6,275 tonnes respectively. Pomfrets in the Kerala waters contribute only 942 tonnes which forms 0·28% of the total marine fish production of Kerala. (All figures relate to the averages of last five years, 1964–1968).[2]

Kerala coastal waters have been one of the most intensely trawled areas in India during the last about 10 years and pomfrets have been caught only in small quantities. It would appear that the shoals caught by *Blue Fin* had migrated from elsewhere. Though pomfrets are known as a migrating group no work has been done in India on this aspect.

The authors express their appreciation of the excellent team-work of Skipper K. Balan and his crew which made this catch of pomfrets possible.

Central Institute of
Fisheries Operatives,
Cochin-16, *November* 29, 1969.

M. C. Perumal.
K. Alagarswami.

---

1. Gopalan, U. K., *International Indian Ocean Expedition Newsletter*, 1967, 4 (4), Abstract.
2. Central Marine Fisheries Research Institute, *Bull. cent. mar. Fish. Res. Inst.*, 1969, No. 13.

BRACHYGNATHIA IN SHEEP AND ITS INHERITANCE

A case of short lower jaw in Chokla breed of sheep is reported. It was found to be associated with rudimentary tongue, absence of teeth and partial development of buccopharyngeal opening. The inheritance of the brachygnathia is suggested to be simple autosomal recessive.

Brachygnathia, overshot or parrot mouth in sheep, where the lower jaw appears too short in comparison to upper jaw, has been described by Rae (1962). From the genetic and economic point of view this condition is important since it is suspected of being inherited and results in lamb losses (Dennis, 1965). A case of brachygnathia has been observed and discussed in this paper.

An otherwise normal female lamb No. C 278 of Chokla breed weighing 3·75 kg. was born to a Chokla ewe No. C 14 on 18-9-1969, with an extremely short lower jaw (Fig. 1). The sire of the lamb was of Chokla breed (No. C 19). Neither the sire nor the dam of the lamb were scored for brachygnathia. The dam (C 14) had no abnormal lamb on previous lambings. During this lambing season C 19 has sired 9 lambs in addition to the one under consideration. None of the members of half-sib family

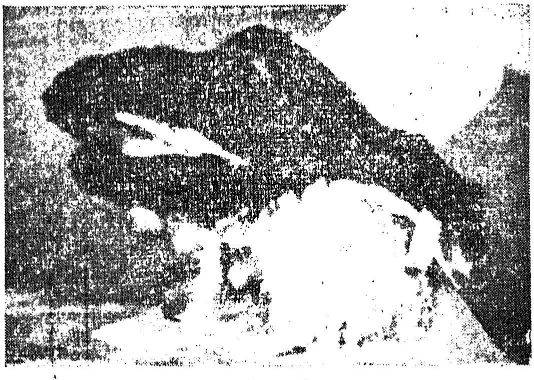


Fig. 1

showed this abnormality. The lamb attempted to suckle the milk from udder but failed. Milk was poured in the mouth, directly and through a nipple but the animal could not swallow. On examination of the mouth it was observed that there was underdevelopment of tongue, and teeth were not present in the lower jaw. Attempts were then made to feed the lamb through stomach tube. It could not be passed through and suggested blockage of bucco-pharyngeal passage. Fingers were inserted for palpation and it was felt that the bucco-pharyngeal passage was blocked. Had the lamb been aided with artificial feeding, it would not have been able to eat independently at later stage ; further, in order to examine the animal in detail it was decided to sacrifice the animal. Saturated magnesium sulphate intracardially was used for euthenesia after 8 hours of birth.

On opening the oral cavity the following abnormalities were observed : (1) Under development of the lower jaw. (half the size of a normal lamb); (2) Complete absence of teeth; (3) Rudimentary tongue (1·0 cm. × 0·5 cm.); (4) A very small bucco-pharyngeal opening which was closed with mucus; (5) Rest of the digestive tract was found to be normal. No abnormalities could be detected in other organs.

Nordby (1935) suggested that brachygnathia may result from a normal maxilla and a short mandible or from normal mandible and long maxilla or over development of maxilla and underdevelopment of mandible. Theret (1948) had described a lamb of Indre Berry breed in which the lower mandible was missing and buccopharyngeal passage closed by mucus membrane. Smith (1968) reported a similar case in a female lamb of Dorset Down breed which had a rudimentary mandible and tongue. Fischer (1955), McFarland and Deniz (1964) and Smith (1968) have described some extreme cases where the mandible was completely missing. In the present study the condition was not so severe; in the lamb under consideration the branchygnathia had resulted from underdevelopment of the lower jaw and normal development of maxilla.

Kelly (1942) reported the inheritance of a short lower jaw and postulated that the condition was due to a recessive gene. In the present case it appears that the character is controlled by a pair of recessive genes. The absence of brachygnathia either in the sire or in the dam rules out the dominance theory of inheritance. Since sire and dam are normal and their offspring exhibited brachygnathia the only hypothesis which can be put forward for the inheritance of this trait is the recessive inheritance. The sire and dam both are heterozygous for this trait and thus not exhibiting it. Nordby *et al.* (1945) in a study of the same condition concluded that the defect resulted from interaction among several pairs of genes some of which are certainly dominant. Smith (1968), however, had no obvious evidence that it was due to either genetic or teratogenic factors. Since no definite mode of inheritance of this trait is established it needs further investigation. It is suggested that half-sib and parent offspring matings may be done which will help to draw a valid conclusion regarding the mode of inheritance.

Central Sheep and
Wool Res. Institute,
Malpura (Rajasthan),
November 29, 1969.

V. K. SINGH.
P. B. MATHUR.
S. K. CHATTOPADHYAY.

---

1. Dennis, S. M., *J. Dep. Agri. W. Aust.*, 1965, **6**, 235.
2. Fischer, H., *Hemera Zoa*, 1955, **62**, 260.
3. Kelly, R. B., *J. Council Sci. Indust. Res.*, 1942, **15**, 189.
4. Mc'Farland, L. Z. and Deniz, E., *Cornell Vet.*, 1964, **54**, 541 (Quoted by Smith, 1968).
5. Nordby, J. E., *Proc. Amer. Soc. Anim. Prod.*, 1935, p. 209.
6. —, Terrill, C. E., Hazel, L. N. and Stoehr, J. A., *Anat. Rec.*, 1945, **92**, 235.
7. Rae, A. L., *Advances in Genetics*, 1956, **8**, 190.
8. Smith, I. D., *Aust. Vet. J.*, 1968, **44**, 510.
9. Theret, M., *Rec. Med. Vet.*, 1948, **124**, 445.

DISTRIBUTION OF ROOT (WILT) PATHOGEN IN DEVELOPING SEED COCONUTS

A SAP transmissible virus was reported to be associated with the root (wilt) disease—a serious menace of coconut in Kerala.[1] The disease was also found to be transmitted by an insect vector *Stephanitis typicus* Distant[2] and through soil.[3] Cowpea (*Vigna sinensis* Endl.) was used as the indicator host for transmission studies.[4] During the course of further investigations, the pathogen was also detected from the pollen of diseased palms. The possibility of the occurrence of the pathogen in the different parts of developing nut was therefore investigated and the results are presented in this note.

Twenty-four coconut trees in early and advanced stages of disease were selected for the study. Nuts under different stages of development were collected from these palms and mechanical inoculations with various parts, *viz.*, husk, kernel and embryo were carried out on 8-day old cowpea (*Vigna sinensis* Endl.) seedlings, grown in insect-proof screen house. Inoculated seedlings were incubated at 75° F. for 24 to 48 hours to ensure good infection. Samples of nuts from twelve trees in advanced stage of infection consistently gave positive infection, whereas those collected from the twelve palms in the early stages of disease did not. Similar tests with parts of nuts collected from comparable number of healthy trees gave no infection at all. In subsequent trials, positive results were also obtained with different parts of sprouting nuts collected from highly diseased palms—plumule, kernel and haustorium, when tested on cowpea seedlings.

Occurrence of the wilt pathogen in different parts of developing nuts is interesting and the possibility of the pathogen being carried to the young growing shoot is being studied.

Central Coconut Res. Station, N. Gopinathan Pillay.
Kayangulam, P. Shanta.
Kerala, *November* 29, 1969. S. B. Lal.

---

1. Nagaraj, A. N. and Menon, K. P. V., *Indian Coconut J.*, 1956, **9**, 163.
2. Shanta, P. Thomas Joseph and Lal, S. B., *Ibid.*, 1964, **18**, 25.
3. Menon, K. P. V. and Shanta, P., *Curr. Sci.*, 1962, **31**, 153.
4. Shanta, P. and Menon, K. P. V., *Virology*, 1960, **12**, 309.

A BRUCHID RESISTANT STRAIN OF BENGAL GRAM

All the three common species of bruchids namely, *Callosobruchus maculatus* Fabr., *C. chinensis* Linn. and *C. analis* Fabr. occur as serious pests of stored pulses including Bengal gram, *Cicer arietinum* L. In replicated experiment to study the preference for egg-laying and development of these insects to three varieties of eight different types of pulses including green gram, black gram, cowpea, lentil, red gram, pea, lathyrus and Bengal gram, it was observed that Bengal gram, G. 109–1, was not preferred by the bruchids for the egg-laying and the development. This strain of gram is a selection made at the Indian Agricultural Research Institute, New Delhi, from an exotic variety introduced from Turkey.

Seeds of the three varieties of each of the pulses were kept in three different sets in a large circular tray with pits made on the periphery for keeping the seeds of one variety separately. Freshly mated female bruchids from laboratory cultures were released one by one through a hole cut in the centre of the tray. The tray with the pulses and the insects was kept in an incubator at 30° C. temperature and 70% relative humidity, which conditions are quite favourable for the development of the bruchids. Experiments with each of the three bruchid species were carried out thrice and the same conditions of temperature and humidity were maintained. When all the released bruchids died, seeds with the eggs, and the number of eggs per seed were counted and the material was again kept in the incubator for studying further development of bruchids in different varieties of the pulses. The percentage of seeds with eggs, average number of eggs per seed, and total time taken in completing the life-cycle on each variety of the pulses were calculated.

The data on the percentage of seeds with eggs laid by *C. maculatus* was analysed statistically and it was found that the differences between pulses and three different sets were highly significant. Also the interaction between the eight pulses under study and the three sets representing different varieties came out to be highly significant which shows that ranking for the egg-laying in general on various pulses in the three different sets was inconsistent. The data when analysed for different types of pulses separately showed that for only gram the differences between varieties was highly significant, whereas, in others there were non-significant differences between the varieties.

Similar trends were observed in the results obtained with the other two species of bruchids, namely, *C. chinensis* and *C. analis* in respect of the same varieties of different pulses under investigations.

Larson[1] observed that in case of *Bruchus quadrimaculatus* Fabr., there seems to be predilection for seeds with smooth and well-filled coats. Srivastava and Bhatia[2] have stated that there is also some unknown factor other than the smoothness of seed, which is responsible for the oviposition preference by *Callosobruchus chinensis* Linn. On close examination of the seeds of G. 109–1, it was observed that the seedcoat is very rough and the coarse surface of the seed might be an important factor responsible for the inhibition of egg-laying by the bruchids. Other factors relating to the mechanism for the resistance are under study. Further studies

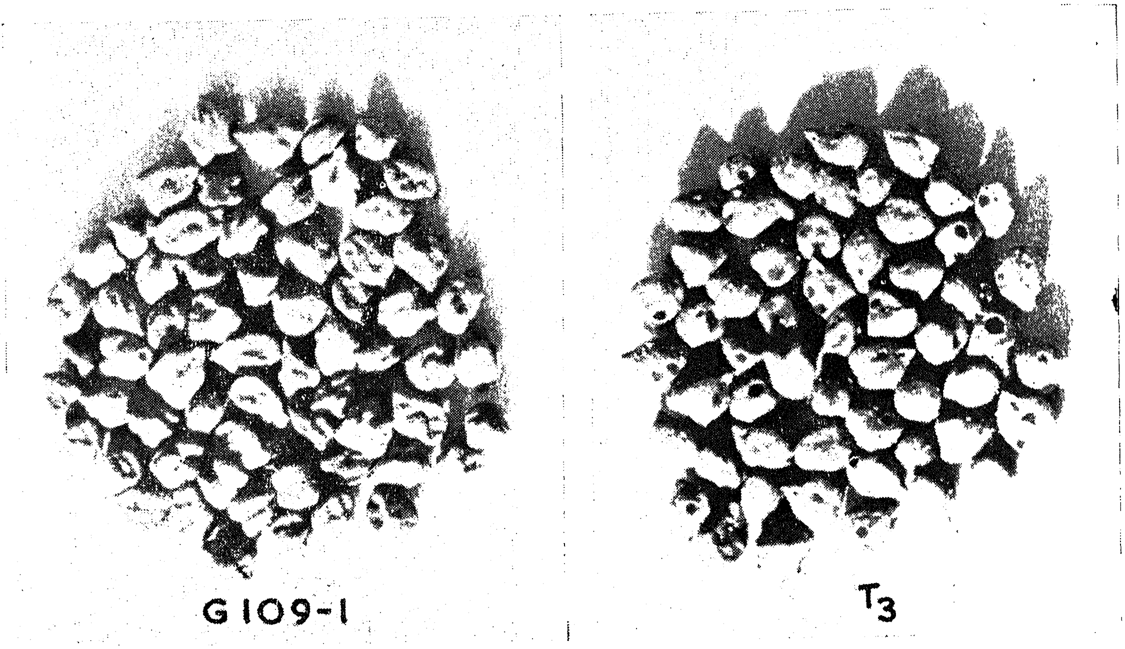


FIG. 1. Photograph showing G 109-1 seeds along with seeds of Bengal gram T_3, a susceptible variety.

have also been taken up at the Indian Agricultural Research Institute, New Delhi, for crossing this bruchid-resistant strain of Bengal gram with high-yielding types with a view to evolving a suitable variety possessing the desired characters namely the bruchid resistance and the high yield.

Thanks are due to Dr. M. S. Swaminathan, Director, Indian Agricultural Research Institute, and Dr. S. Pradhan, Head of the Division of Entomology, I.A.R.I., New Delhi, for their valuable suggestions and keen interest in these investigations.

Division of Entomology, H. P. SAXENA.[*]
Indian Agri. Res. Institute, A. K. RAINA.[‡]
New Delhi, *January* 1, 1970.

---

[*] Entomologist, Indian Agricultural Research Institute, New Delhi.

[‡] Formerly Senior Research Assistent, USAID/Regional Pulse Improvement Project.

1. Larson, A. C., "The host selection principle as applied to *Bruchus quadrimaculatus* Fabr.," *Ann. Ent. Soc. Amer.*, 1927, **20** **(1)**, 37.
2. Srivastava, B. K. and Bhatia, S. K., "The effect of host species on the oviposition of *Callosobruchus chinensis* Linn.," *Annals of Zoology*, 1959, **3** (3), 37.

A NOTE ON HETEROSIS IN GREEN GRAM (*PHASEOLUS AUREUS* ROXB.)

THERE is abundance of literature on hybrid vigour in many of the cross as well as the self-fertilised crops,[1,2] but in green gram which is self-fertilised, available information is very scanty. Hence the present study was undertaken.

The F_1 hybrids of an intervarietal cross between Nayagarh 2-4 (P_1) as female parent and Kopergaon (P_2) as the male parent were studied during *Kharif* 1969 for heterosis and detailed observations on characters like (1) plant height, (2) number of primary branches, (3) leaf size, (4) total number of pods per plant, (5) pod size, (6) number of seeds per pod, (7) 100 seed weight, and (8) plant yield were recorded. The mean value of each character of P_1, P_2, mid-parent, F_1 and the percentage increase of F_1 over each parent are presented in Table I.

It is encouraging to note from Table I that out of 8 characters taken for study, hybrid vigour is observed in 6 of them. As regards the other two characters, namely, pod size and 100 seed weight, though hybrid vigour is not manifest over the superior parent P_2, yet they maintain their superiority over mid-parent and

TABLE I

Showing mean of different characters under study and increase per cent of F_1 over parents

Characters	P_1	P_2	Mid-parent	F_1	Percentage of increase of F_1		
					Over mid-parent	Over P_1	Over P_2
1. Plant height in cm. ..	53·33	50·66	51·96	56·33	9·10	5·62	11·32
2. Number of primary branches ..	4·33	2·00	3·16	4·66	47·46	7·62	133·00
3. Leaf size in cm. ..	79·20	166·83	123·01	178·05	44·74	124·93	6·72
4. Total number of pods per plant ..	42·33	22·33	32·33	49·66	53·60	17·31	122·39
5. Pod size (Length × Girth) cm. ..	5·19	10·10	7·64	9·43	23·42	81·69	..
6. Number of seeds per pod ..	10·66	9·60	10·13	11·66	15·10	9·38	21·45
7. 100 seed weight in grams ..	2·226	5·300	3·763	3·835	1·91	72·28	..
8. Yield per plant in grams ..	7·560	9·990	8·775	15·746	79·44	108·28	57·58

P_1. Further it is interesting to note that the grain yield of F_1 hybrid exhibits a remarkable increase of 79·44%, 108·28% and 57·88% over the mid-parent, P_1 and P_2 respectively.

The authors are grateful to the Director of Agriculture and Food Production, Orissa, Bhubaneswar, for facilities and encouragement.

Pulses Res. Station, R. C. MISRA.
Nayagarh (Orissa), R. C. SAHU.
November 1, 1969. D. TRIPATHY.

---

1. Jeswani, L. M., *Proceedings of the Second Annual Workshop Conference on Pulses*, I.A.R.I., 1968.
2. Joshi, A. B. and Dhawan, N. L., *Indian J. Genet. Pl. Breed.* (Special Symposium Number), 1966, **26 A, 101.**

SERODIAGNOSTIC METHOD FOR DETECTING MOSAIC INFECTED CASSAVA PLANTS IN FIELD

MOSAIC disease of cassava (*Manihot utilissima* Pohl.) is posing a serious threat to the cultivation of the crop in the Southern states of the country, especially Kerala. The disease is characterised by severe mosaic symptoms with malformation and distortion of the leaflets due to stresses set up by the unequal enlargement of adjacent areas. The typical picture is a leaf reduced in size, misshapen and twisted, with bright yellow areas separated by near normally green.[4] Methods of transmission and host range of the virus have been worked out by Storey and Nichols.[5,6]

Considering that the disease is transmitted in nature through the agency of white flies (*Bemisia* sp.) it is important to trace the diseased plants in the field and rogue them out before it spreads to other plants in the cassava plantation. Therefore, a rapid serological method was developed to identify the diseased plants in the fields.

The virus could be purified from the infected leaves of cassava using phosphate buffer for extraction followed by two cycles of high speed and low speed ultra-centrifugations (Beckman Model L) in the following way. 100 g. of leaf material was macerated in a Waring blender and sap extracted with two volumes of 0·1 M phosphate buffer (pH 7·0) *plus* carbon tetrachloride at the rate of 25 ml. for 200 ml. of extract. The solution was then shaken well in volumetric flask and allowed to stand for 10 minutes to remove plant proteins. It was then filtered through muslin cloth and the filtrate centrifuged for 25 minutes at 10,000 r.p.m. The pellet was discarded and the supernatant liquid was again centrifuged at 30,000 r.p.m. for 120 minutes in Spinco R 40 Rotor. The supernatant liquid was discarded and the pellet was suspended in 0·01% ammonium acetate (pH 7·0) and centrifuged at 8,000 r.p.m. for 30 minutes. This time the pellet was discarded and the supernatant liquid was again centrifuged at 40,000 r.p.m. for 120 minutes. The supernatant liquid was discarded and the pellet was resuspended in 0·01% ammonium acetate and filtered through Whatman No. 1 filter-paper. The filtrate containing purified virus was collected and preserved at 5° C. All stages of purification were carried out at 24–27° C.

1 ml. of the purified virus was then injected in the marginal vein of an albino rabbit twice

weekly with a hypodermic syringe. To ensure to have better antisera 1 ml. of this purified preparation mixed with equal proportion of Freunds adjuvant was also injected intraperitoneally along with every intravenous injection. In all ten injections were administered in a single rabbit. The rabbit was then bled 10 days after the last injection and the blood allowed to clot when the serum was separated. The clear serum was obtained after centrifuging the blood for 10 minutes at 3,000 r.p.m. and preserved by addition of a few drops of chloroform, 0·1% phenol or 50% glycerol and kept in a cool place.

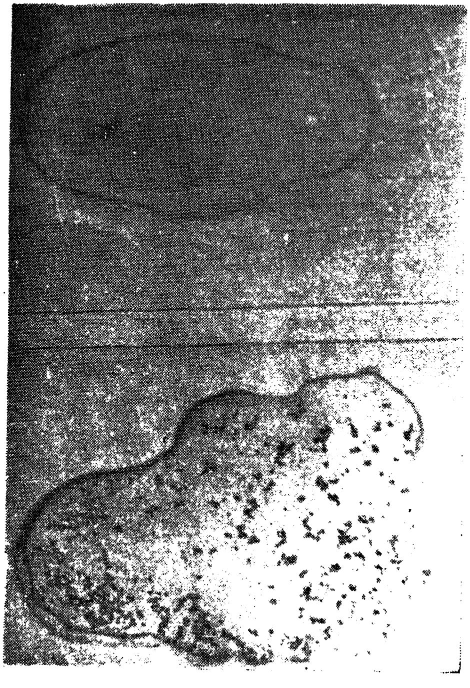


FIG. 1. Slide agglutination test: top showing no reaction with normal serum and bottom showing positive agglutination with antiserum.

Rapid agglutination tests were made to locate the diseased plants under the field conditions in the experimental plots of the Indian Agricultural Research Institute at New Delhi, in the similar manner as described by Ganguly,[2] Bradley[1] and Munro.[3] Sap from a young leaf of the suspected plant was squeezed and one drop each was put on two glass slides. A drop of antiserum was then added to one of them and a drop of the normal serum to the other. The drops were stirred with opposite ends of a tooth-pick which was then discarded. Agglutination, that is, clumping together of host material (Fig. 1) was observed within 20–25 seconds of stirring in the drop containing antiserum while the drop containing normal serum remained unchanged. The agglutination can be detected even with naked eyes. The infected plants after detection can be rogued out thereby checking the further spread of the virus.

The technique will be of great help in elimination of primary infection in this propagative material, thereby ensuring better growth and yield of the crop. The chief merits of this technique are that the procedure is very simple, it requires no prior treatment of infective crude sap, and it needs very little quantity of antiserum for the reactions.

The authors are grateful to Dr. M. S. Swaminathan, Director, Indian Agricultural Research Institute, New Delhi, for his great interest in this project. Thanks are due to PL 480 authorities, A.R.S., U.S.D.A., for financial support.

Division of Mycology and Plant Pathology,
Indian Agricultural Research Institute,
New Delhi, *January* 27, 1970.

B. GANGULY.
S. P. RAYCHAUDHURI.
B. C. SHARMA.

---

1. Bradley, R. H. E., *Amer. Potato J.*, **1952, 29, 289.**
2. Ganguly, B., *Sci. & Cult.*, **1966, 32, 95.**
3. Munro, J., *Amer. Potato J.*, **1954, 31, 73.**
4. Smith, K. M., *A Text-Book of Plant Virus Diseases*, J. & A. Churchill Ltd., London, p. 130.
5. Storey, H. H. and Nichols, R. F. W., *Ann. Appl. Biol.*, **1938, 25, 790.**
6. — and —, *E. Afric. Agri. J.*, **1938, 3, 446.**

REVIEWS AND NOTICES OF BOOKS

Annual Review of Phytopathology (Vol. 7). Edited by J. G. Horsfall. (Annual Reviews, Inc., 4139 El Camino Way, Palo Alto, California, U.S.A.), 1969. Pp. 477. Price $ 8.50 in U.S.A.; $ 9.00 elsewhere.

Volume 7 of this well-known series contains the following articles: Prefatory Chapter: A Perspective on Plant Pathology, by S. E. A. McCallan; Historical: History of Plant Pathology in Great Britain; Appraisal of Disease: Economic Bases for Protection Against Plant Diseases; Pathogens: Epidemiology and Control of Bacterial Leaf Blight of Rice; Insect Tissue Cultures as Tools in Plant Virus Research; Cellular Responses of Plants to Nematode Infections; Culturing of Rust Fungi; Parasexuality in Plant Pathogenic Fungi; Morphology and Anatomy: Biochemistry of the Cell-Wall in Relation to Infective Processes; Physiology of Host-Pathogen Interaction: The Role of Phenolics in Host Response to Infection; Genetics of Host-Pathogen Interaction: Resistance of Malus to Venturia Inaequalis; Epidemiology-Disease in Population: Modes of Infection and Spread of Fomes Annosus; Irrigation and Plant Diseases; Influence of Environment: Soil Water in the Ecology of Fungi; Action of Toxicants: Effect of Fungicides on Protein and Nucleic Acid Synthesis; Chemical Control: Heat Therapy of Virus Diseases of Perennial Plants: Breeding for Resistance: Multiline Cultivars as a Means of Disease Control; Progress in the Development of Disease-Resistant Rice; Special Topics: Use of plant Pathogens in Weed Control; and Other Reviews of Interest to Plant Pathologists.
C. V. R.

Axenic Mammalian Cell Reactions. Edited by George L. Tritsch. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 413. Price $ 18.75; £ 8-18 *sh.*

The book under review describes first-hand accounts of studies with cultured mammalian cells. They serve to illustrate the areas in which these cells have given meaningful information not obtainable with other experimental systems. The reader will share the excitement of working with isolated, living cells and will become aware of the technical and conceptual difficulties encountered in this work.

Axenic Mammalian Cell Reactions presents the views of scientists actively engaged in cell culture from the point of view of the anatomical and the molecular biologist.

The chapters contained in this book are: The Establishment of Mammalian Cells in Culture, by Audrey Fjelde; Cytogenetics of Hematopoietic Cells in Long-Term Culture, by Nobuo Takagi and Avery A. Sandberg; Transformation of Primary Human Amnion Cells with Simian Virus 40, by Jorgen Fogh, Luciano Ramos, and Helle Fogh; Genetic-Like Properties of Exogenous DNA in Mammalian Cells, by J. Leslie Glick; The Role of Exogenous RNA in Cell Function, by M. C. Niu; The Study of Enzyme Regulatory Mechanisms in Cultured Cells by Robert T. Schimke; Selectivity in Inhibition by Antimetabolites, by Maire T. Hakala; The Effects of Narcotics on Cells in Tissue Culture, by Eric J. Simon; The Use of Isolated Thyroid Cells in Studies of Thyrotropin Actions, by Winton Tong; Physiology of the Cultured Mammalian Cell, by William F. McLimans; and The Role of Peptides in the Control of Growth, by George L. Tritsch.

Life scientists and clinicians who are concerned with mammalian cells and who wish to study not only the cells themselves but the factors that result in normal and abnormal cellular organization, will find this book highly valuable.
C. V. R.

Luminescence of Biopolymers and Cells. By G. M. Barenboim, An. Domanskii, and K. K. Turoverov. (Translated from Russian—Translation edited by Raymond F. Chen.) (Plenum Press, New York and London), 1969. Pp. viii + 229. Price $ 12.50.

This monograph presents a succinct summary of the fundamental principles of fluorescence and phosphorescence research as applied to proteins, nucleic acids, and their components, both *in vitro* and *in vivo.* The authors supply all necessary basic knowledge and review much of the Soviet and Western literature. Major areas of discussion are bioluminescence, biochemiluminescence, and ultraviolet fluoromicroscopy. Topics fully developed are the excitation of biological macromolecules by high-energy radiation, the use of fluorescence measurements to assess the mechanisms of radiation damage, and the emission of "ultraweak" ultraviolet light by living tissues —an area of research new to the United States. The authors also describe the unique design of an ultraviolet microscope and, finally, discuss the directions for future research and the potentialities of luminescence techniques.

This book will be of interest to biochemists, molecular and radiation biologists, physical chemists, medical and graduate students, and all those involved in industries dealing in optics, spectrometers, and microscopes. C. V. R.

Advanced Inorganic Chemistry. By F. Albert Cotton and Geoffrey Wilkinson. (Wiley Eastern Private Limited, Publishers, J. 41, South Extension 1, New Delhi-49). Pp. 1136. Price Rs. 22·50.

This text-book of modern inorganic chemistry written at an advanced level has been very popular with students of chemistry since its first publication in 1962. It is now made available as the First Wiley Eastern Reprint at a very reasonable price to enable any advanced student to own his copy. The reprint is from the second edition published in 1967 at the price of $ 15.95. This edition has been carefully revised, enlarged and brought up-to-date by including vast amount of recent literature. The comprehensive treatment which emphasizes many new developments especially on the theoretical side dealing with the interpretation of bonding and reactivity in inorganic compounds will appeal to students of modern inorganic chemistry. The extensive references to original literature will make the book useful to research workers also.

A. S. G.

Fundamentals of Heat. By D. S. Mathur. (Sultan Chand & Sons, Publishers and Booksellers, Amir Chand Marg, Nai Sarak, Delhi-6), Pp. 810. Price Rs. 12.50.

This is the second and revised edition of the popular book on Heat for Degree classes. The new edition includes three appendices, namely, (*i*) the radiation laws of Wien, Rayleigh and Planck, (*ii*) the third and zeroth laws of thermodynamics, and (*iii*) the Statistical Theory of Boltzmann, Bose-Einstein and Fermi-Dirac. The new edition will be widely welcomed by students. A. S. G.

Advanced Practical Organic Chemistry. By J. L. Norula. (Sultan Chand & Sons, Publishers and Booksellers, Amir Chand Marg, Nai Sarak, Delhi-6), 1970. Pp. 380. Price Rs. 9.00.

This book with a wide coverage gives a survey of the techniques and methods involved in purification, characterization, identification, estimation and syntheses of organic compounds. The subject-matter is dealt with under the following main heads: Technique of Organic Laboratory Processes; Characterization and Identification of Pure Organic Compounds; Reactions of Functional Groups and Formation of Derivatives; Quantitative Analysis; Preparations; Instrumental Methods; and Appendix. Useful references are given at the end of each chapter.

As a supplementary laboratory guide, the book will be suitable for graduate and honours courses in organic chemistry in Indian Universities. A. S. G.

Books Received

British Medical Bulletin—Immunization Against Infectious Diseases (Vol. 25, No. 2, May 1969), (The Medical Department, The British Council, 97 and 99, Park St., London W. 1), Pp. 119–218. Price £ 2.0.0, $ 6.50.

Annual Review of Genetics (Vol. 3). (Annual Reviews, Inc., 4139, Camino Way, Palo Alto, California 94306, U.S.A.), 1969. Pp. vii + 585. Price U.S.A.: $ 8.50, other countries: $ 9.00.

Advances in Chromatography (Vol. 8). Edited by J. Cavin Giddings and R. A. Keller. (Marcel Dekker, 95, Madison Avenue, New York 10016), 1969. Pp. xvi + 400. Price $ 18.75.

Chemical and Botanical Guide to Lichen Products. By C. F. Culberson. (The University of North Carolina Press, Chapel Hill), 1969. Pp. xi + 628. Price $ 12.50.

Basic Biochemical Calculations—Related Procedures and Principles. By J. S. Finlayson. (Addison-Wesley Publishing Co., Reading, Mass.), 1969. Pp. 329. Price 43 *sh.*

1912–70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

NUTRITION SEMINAR

F. WOKES

Vegetarian Nutritional Research Centre, 1, Ellwood Gardens, Garston,
Watford, Herts, England

An eight-day seminar in Nutrition was organized by the Biochemistry Department of the Maharaja Sayajirao University from 15th to 22nd February, 1970 under the auspices of the University and the University Grants Commission. The scope of the seminar was comprehensive covering as it did various aspects ranging from brain biochemistry to solutions of the food problem and gave an opportunity for scientists concentrating on a particular field to acquire an overall perspective.

The seminar started with an excellent inaugural address by Dr. C. S. Patel, the Vice-Chancellor of the University, whose address neatly summarized the varied scope of nutrition as a science and emphasized the need for studying problems such as nutritional adaptation.

The first day started with Pirie's review of different potential protein sources of food for man and emphasized that leaves are unsurpassed in their ability to trap the energy of sunlight into carbohydrates, fats and proteins. Narendra Singh, the next speaker, reported that in his extensive investigations on 27 leafy plants the highest yields of protein, in kg./ha. were obtained from plants such as lucerns (800) and knolkhol (165) whereas pulses such as horsegram (20) and *Phaseolus trilobus* (44) gave the lowest yields. In 15 species the contents of essential amino-acids, expressed as g./16 g. N, were methionine, 1·4–2·1, lysine, 5·0–6·5, and threonine, 4·5–6·8. The nutritive values of these proteins were brought nearly up to those of milk protein by fortification with lysine and methionine. Similar though less detailed findings were obtained by R. N. Joshi on leaf proteins from some plants of Aurangabad.

Much detailed information on single-cell protein from petroleum hydrocarbons was provided in two separate reviews by M. S. Iyengar and V. R. Siste. Experimental results in Dartmund on green algæ, *Scenedesmus*, were described by W. Feldheim. A short paper by Mrs. Baruah gave a most interesting account of protein obtained from blue-green algæ, a traditional food in Lake Chad. The nutritional aspects of single-cell protein were discussed by H. D. Singh.

Other foods which are produced by conventional techniques but not widely used were reviewed by Kamala Sohonie and A. D. Phadnis. Radha Pant discussed the protein composition of wild legumes.

The morning of the second day was devoted to the important subject of nutrition and brain function. A very good review by R. J. C. Stewart on maternal diet and development of the offspring was presented as a tape recording with accompanying slides owing to Dr. Stewart's inability to come to India. Several members of the Baroda team headed by Dr. Rajalakshmi and Prof. Ramakrishnan spoke on the effects of different types of nutritional stress on selected enzymes of glutamic acid metabolism as well as certain behavioural parameters. Some of the aspects presented were neonatal food restriction, comparative effects of calorie and protein deficiencies, minimal level of dietary protein needed to prevent brain changes, the relative importance of maternal and post-weaning diets, effects of vitamin deficiencies, and protein quality of the diet, effects of glutamic acid supplementation, etc. (E. Jacob, P. S. Joshi, M. Parameshwaran, Suresh Sail, P. Subba Rao, K. V. Thrivikraman and C. M. Upadhyay). Some interesting findings that emerged from the tremendous mass of data presented were that protein deficiency affects brain glutamic dehydrogenase and decarboxylase and that this effect is found even in adult animals. In contrast calorie deficiency was without such effect except in the neonatal period. Vitamin A deficiency produced effects similar to those of protein. The protein content of the post-weaning diet seemed more crucial than that of the maternal diet. Glutamic acid was found to reverse the effects of a low protein diet. The addition of leafy vegetables and legumes to the poor Gujarati diet was found to increase brain enzymes to normal levels. Some papers were presented on the regional distribution of metabolites and enzymes in different regions of the brain and their susceptibility to change with protein deficiency.* The session concluded with a comprehensive review on nutrition and brain function by Ramakrishnan.

The session aroused considerable interest among several participants and an additional panel discussion was arranged at their request over which Dr. Johnson presided. Prof. Udani Dr. Rajalakshmi, Dr. Kaul, Dr. Parikh, Dr. Shanmugasundaram and Prof. Ramakrishnan participated in this discussion. Prof. Udani also gave a talk later on the brain changes found in children who died of severe malnutrition which resembled the histological changes found in experimental animals by Platt and Stewart.

The afternoon session dealt with the fortification of foods. A review by P. R. Krishnaswamy dealt with amino-acid fortification of cereals. The fortification of processed foods with limiting amino-acids was discussed in a review by Parpia, Swaminathan and Daniel. The technology of fortification was presented by G. C. Jain from the Salt Research Institute. A short paper reported studies on rats in which salt fortified with calcium, iron, lysine or vitamin A had a beneficial effect on the relevant parameters, namely, bone calcium, blood hemoglobin, liver, iron, serum protein and liver vitamin A (A. K. Charles). Another short paper compared the nutritive value of modern bread with that of a standard 10% casein diet and 'debras' (rotis) made of cereal, 80 g., legume, 20 g. and greens, 20 g. Unexpectedly weight gain with modern bread (6–7 g. per week) was less than that obtained with the other 2 diets (10–11 g.) (P. Subba Rao).

The morning of the third day was devoted to energy metabolism. A comprehensive review by Banerjee gave valuable data on basal energy requirements in different groups of Indians and the energy cost of different types of activities. The basal energy requirements were reported to be 15–20% less per square meter of body surface than Aub Dubai norms. An interesting paper presented by Guharay compared oxygen utilization of Indian and Swedish coal miners for similar types of work and found the same to be similar when differences in body size were taken into account. Another paper presented raised the question of energy balance during lactation as food intakes were 400 calories less than estimated requirements in nursing mothers who were not losing body weight. A similar discrepancy was not found in groups of pregnant and control women (G. Subbulakshmi).

The afternoon session was held in Anand in collaboration with Sardar Patel University and dealt with food production targets and possibilities. A review by Wokes summarized FAO data on world food production and consumption in 1960–1975. He pointed out that instead of the proposed increase in intake of animal protein from 9–15 g. it would be better to plan on an increase from 9–12 g. as this economy would enable the production of an additional 15–30 g. of plant protein and wipe-out protein calorie malnutrition. Other papers presented discussed the possibility of attaining self-sufficiency in cereals and pulses (V. S. Vyas), of high yielding strains (A. K. Kaul) and the potential increase in milk production (B. M. Patel). A review by C. V. Ramakrishnan discussed the present gap between consumption and recommended intakes of different nutrients in different age groups and emphasized that increased cultivation of tubers, pulses, leafy vegetables, and other vegetables and fruits rich in carotene can correct all the deficiencies in the poor man's diet without involving much additional pressure on land or purse.

The morning of the fourth day was devoted to a discussion of protein. Experimental techniques for the assessment of protein quality was discussed by M. Narayana Rao. An interesting paper on amino-acid changes in the cereal grain with maturation because of the increase in certain protein fractions was presented by A. S. Naik. A review on serum protein and albumin and changes in the same and in the albumin, globulin ratio in different conditions was presented by G. Rajagopal. The effects of variations in dietary protein content and quality on lipid metabolism were discussed in a review by T. A. V. Subramanian. A most interesting paper on prolonged negative balances with regard to nitrogen in apparently healthy subjects in New Guinea was presented by H.A.B.P. Oomen. Fecal losses often matched or exceeded dietary intakes in these subjects. This could be explained by the presence of N_2 fixing bacteria found in the feces. The question whether the protein synthesized by these bacteria is of any value to the host remains to be answered by further investigations. Comparative data on maize and jowar suggested that the niacin deficiency in both may be the result of an amino-acid deficiency as well as imbalance (D. Peramma). Comparative studies on school boys consuming wheat, rice, and maize in Banaras, Madras and Gujarat respectively showed practically no difference in the nutritional status as judged by height, weight, serum protein, albumin, vitamin A and vitamin C, blood Hb and the urinary excretion of creatinine, thiamine, riboflavine, vitamin C and nicotinic acid. No differences were found in performances on selected psychological tasks. The urinary excretion of thiamine tended to be somewhat lower in the Madras group whereas that of N'-methyl nicotinamide was somewhat lower in the Gujarat group (K. N. Chandrasekaran).

---

* R. Rajalakshmi and C. V. Ramakrishnan, *Nutrition, Learning Performance and Brain Biochemistry*.

The fifth day started with a short but interesting session on nutrition and infection. Dr. De Sweemer gave a valuable review of the work of Scrimshaw and his colleagues and her own detailed findings in selected villages in Punjab. In these villages a combination of nutritional and medical care was found to achieve a substantial reduction in morbidity although either alone had also some effect.

An interesting paper by Ina Dhanda presented the effects of protein deficiency in monkeys on phagocytic activity of the reticuloendothelial system.

The next session on carbohydrates and fats began with an excellent review by B. C. Johnson on physiological and biochemical responses of carbohydrates or fats as sole energy source. Short papers were read on effects of variations in the content of sugar, groundnut oil and hydrogenated fat on rat growth, liver vitamins and serum cholesterol (A. M. Rao and K. N. Dileepan). All the three produced increases in serum cholesterol; greatest increases were found with sugar and the least with groundnut oil. The results suggest that both quality and quantity of fat determine the levels of serum cholesterol. A clinical syndrome characterised by diarrhea retarded growth and irritability in some children fed large quantities of milk (80 ounces) without sugar was described by Usha Parikh. Dramatic improvement was noted with reduction in the quantity of milk and the introduction of sugar.

The sixth day started with a very interesting paper on the nutritive value of different strains of rice and the effects of different doses of fertilizers on the same was presented by A. K. Kaul.

The subsequent sessions for the day were concerned mainly with vitamins A, C, and B_{12}. Comprehensive reviews on the function of vitamin A at molecular level (B. C. Johnson) and on vitamin A and carbohydrate metabolism (V. N. Singh) raised many interesting questions. Papers reporting animal and human studies suggested the excellent availability of carotene in leafy vegetables (Kamala Chari and Suresh Sail). A comprehensive review on vitamin C metabolism with special reference to nutritional factors was presented by G. C. Chatterjee. The next paper gave convincing evidence of a negative balance with regard to vitamin C in lactating women (G. Subbulakshmi) in spite of which normal blood levels of the vitamins were maintained. A short paper described the mutual effects of thiamine and riboflavine supplementation on the urinary and liver concentrations of the vitamins in rats (G. A. Tamam). A review on vitamin B_{12} in nutrition with special reference to neurological aspects and cyanide metabolism was presented by Wokes. The next paper on the effects of B_{12} supplementation on blood hemoglobin and psychological performance in poor man suggested that it is not a limiting nutrient in diets consumed by the poor (Suresh Sail). The effects of vitamin B_{12} deficiency and excessive intakes of valine and methionine on RNA metabolism in micro-organisms were discussed by B. C. Johnson.

The next session of the day was devoted to processing procedures such as fermentation, sprouting, roasting and parching. The role of different bacteria in the production of traditional foods such as bread-wine, fermented milk, cheese and soya-bean products (*e.g.*, miso, natto and tempeh), the preparation of fermented products from rice, African locust, maize, cabbage taro, peanuts, blackgram and other Indian pulses was described in a scholarly review (J. V. Bhat). Papers were presented on the effects of sprouting and fermentation on nutritive values, including vitamins B_1, B_2 niacin and C (K. K. Sakariah) and studies on micro-organisms involved in dhokla fermentation (S. R. Nadkarni). The development of several processed foods for infants and young children was described by M. R. Chandrasekhara.

The morning session concluded with a paper on the chemical composition and biochemical make up of the placenta in poor and upper class women (L. J. Parekh) and an important review on gestation and lactation performance of poor Indian women by R. Rajalakshmi.

The afternoon session dealt with toxic factors in foods. There were important reviews on trypsin inhibitors and hæmagglutanins (K. Sohonie), mycotoxins (E. R. B. Shanmugasundaram), neurotoxins (R. Shanmugasundaram), aflatoxins (L. Vishwanathan), pesticide residues in foods (Mazumdar) and food adulterants (O. S. Chadha) all providing much useful information. These were supplemented by papers on hæmagglutanins in Indian legumes (L. D. Mange), trypsin inhibitors from eggs (O. M. Simlot) and steps to limit pesticides in foods (S. V. Pingale).

The morning session of the seventh day started with a valuable review on problems concerning calcium requirements by R. Rajalakshmi. This was followed by papers on the effect of dietary protein content and quality on bone calcium (C. M. Upadhyaya) and calcium incorporation in acid foods (S. Vijayaraghavan).

The second session in the morning dealt with anemia. An interesting review on hyperlipoprotenemia was presented by H. G. Morgan. This was followed by papers on the etiology of nutritional anemia in pregnancy by R. V. Bhatt and the etiology and incidence of nutritional anemia by Meera Mathur. The former said that maternal mortality was associated with very low levels of blood hemoglobin. The data presented by the latter confirmed the general impression that iron deficiency was the major etiological factor in the widespread incidence of anemia in this country.

The afternoon session was devoted to nutrition education and applied nutrition programmes. Comprehensive reviews dealt with a blue-print for a mass communication programme (S. Ghose), the sociopsychological and nutritional dimensions of nutrition education (D. Deulkar), the food and nutrition problems of India *vis-a-vis* the applied nutrition programme (Ram Das) and the role of AFPRO in alleviating malnutrition (A. P. Perquin). R. P. Parlato gave a talk on the scope and objectives of the CARE programme, which, he said, included nutrition. There was also a short paper on nutrition education by M. B. Buch.

The final session on the eighth day was held in Ahmedabad ATIRA auditorium under the joint auspices of Community Sanskar Kendra and dealt with the nutrition and growth of children. Ramakrishnan gave a review on the formulation and evaluation of low cost meals for pre-school children in which he described dietary formulations based on cheaply available foods for young children which were tested by field trials for two consecutive periods of 7 months each. The next paper on longitudinal studies on children from birth to 5 years (G. Subbulakshmi) described studies on children in the low income group who were investigated every three months. They showed considerable growth retardation after the first 6 months but no psychological retardation was found. In contrast, children suffering from kwashiorkor were found to show gross impairment in psychological performance. The difficulties in getting reliable measurements on height and the greater reliability and sensitivity of weight as an index of growth in young children were described by C. De Sweemer in her paper on methodology of growth surveilliance in children under 5 years. A. S. Chikrumani read a paper on pediatrician and the problem of childhood under nutrition.

The seminar was a very stimulating and enjoyable one with plenty of scope for lively discussion. Contemporary problems such as fortification with lysine and other nutrients the use of processed foods and hybrid strains were subjects of lively debate.†

---

† Some selected reviews and papers presented at the seminar are to be published by the Department of Bio chemistry as "Perspectives in Nutrition". Interested individuals and institutions should contact Prof. C. V. Ramakrishnan, Head of the Biochemistry Department, M.S. University, Baroda, India.

THE DEVELOPMENT OF *GNATHOSTOMA SPINIGERUM* OWEN, 1836, IN ITS FIRST INTERMEDIATE HOST, *MESOCYCLOPS LEUCKARTI* CLAUS, 1857, IN INDIA WITH REMARKS ON ITS ZOONOTIC IMPORTANCE

D. J. CHELLAPPA* AND M. ANANTARAMAN**

(Department of Parasitology, Madras Veterinary College)

GNATHOSTOMA SPINIGERUM, a spirurid nematode of cats and dogs is known to occur as an accidental parasite of man in Japan, China, Thailand, Malaya and India. Mitter (1910) recorded the parasite from a domestic cat in Calcutta. He also cited that Lewiss found the parasite in a pariah dog in the same city. Later (1912), he recovered it from a dog and a leopard (*Felis pardus*). Chandler (1925 *a*) encountered the adult parasite in 13 out of 250 cats, and he observed that the incidence of the infection was seasonal. The same worker (Chandler, 1925 *b*) successfully infected cats by feeding them with cysts of larvæ obtained from snakes in the Zoological Gardens, Calcutta. With eggs of the worm obtained from a dog at Patna, Varma (1955) studied the development of the embryo in fæcal culture. Its prevalence in cats in Madras and Bombay was estimated as 1 in 50 (Alwar and Lalitha, 1958), and 1 in 40 (Rao and Kulkarni, 1964) respectively.

Reports of human infection in India are restricted to Bengal. Maplestone (1929) reported the first instance, while Maplestone and Bhaduri (1937), Maplestone and Rao (1939), and Mukerji and Bhaduri (1945) added several more.

Early studies on the life-history of the worm were made in Thailand (Prommas and Daengsvang, 1933, 1936, 1937) revealing the intermediate hosts involved. Since then, confirmatory observations have come from Japan and the Philippines. Refuerzo and Garcia (1938) described the development of the eggs in copepods, probably *Eucyclops* sp., and *Mesocyclops bicolor,* in the Philippines, and Miyazaki (1960) reported that the copepods *Mesocyclops leuckarti, Eucyclops serrulatus, Cyclops strenuus* and *C. vicinus* have been experimentally determined to be the first intermediate hosts in Japan. No literature is available on the first intermediate hosts of the worm in India, though its incidence in Calcutta, Madras and Bombay has been well established.

In the present study, only one (stray, female) of 37 cats examined showed Gnathostome eggs in the fæces. The cat was maintained in the laboratory for four months, from 19th August 1968 until autopsy on 18th December 1968, and material for culture and infection was derived from it.

The eggs were oval, with a distinct polar cap, and a greenish tinted shell ornamented with fine granulations, and were invariably in the single- or two-celled stage in the fresh fæces. They measured 66·7 × 37·5 μ. Eggs separated from the fæcal mass by flotation or sedimentation methods were cultured in water for development (Fig. 1). Hatching occurred in 8–18 days during October-November, when the average room temperature was 28° C.

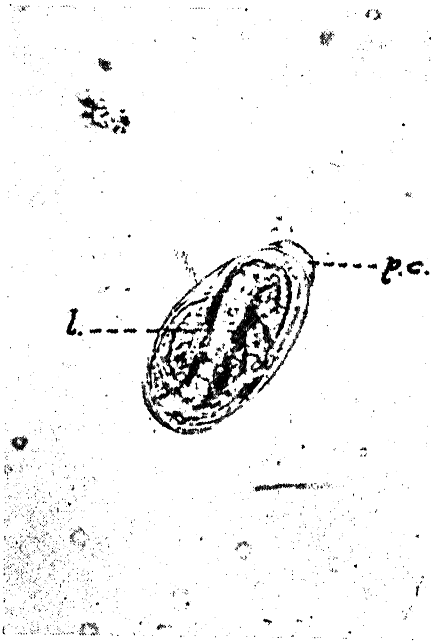


FIG. 1. Egg of *G. spinigerum* with vermiform embryo (first stage larva). *l* = larva; *p.c.* = polar cap.

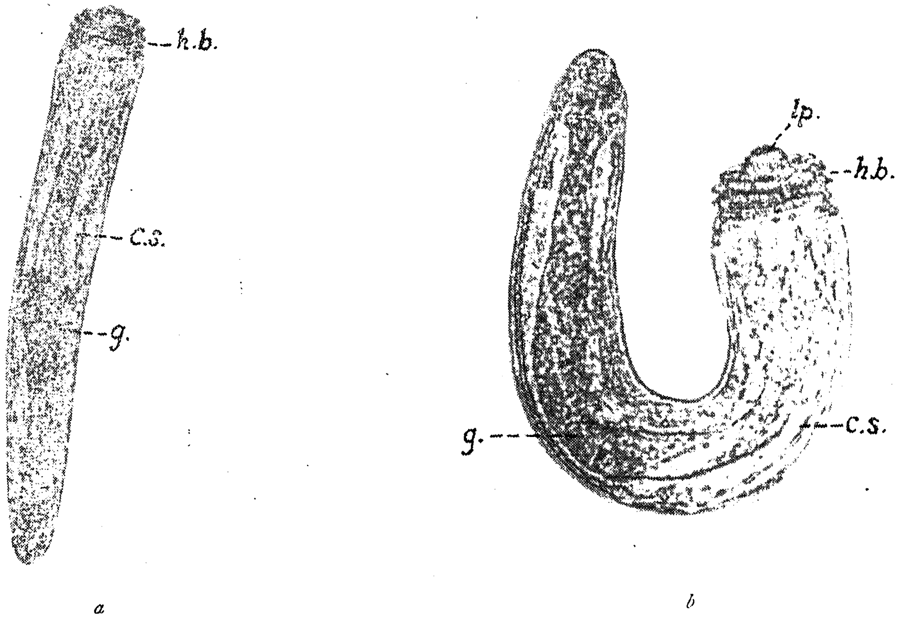
The first stage larva is slender, with one end rounded and the other pointed, sheathed, and measures 242–267 × 12–13·3 μ. It shows active lashing movements though progressing slowly. Such larvæ, if not swallowed by Cyclops, died in 48–72 hours. Individuals of cyclops were obtained from freshwater ponds in Red

---

Present address :—

* Veterinary Dispensary, Pennadam, S. Arcot.

** 6, Nageswara Iyer Road, Madras-34.



FIGS. 2 *a*–2 *b*. Second stage larvæ of *G. spinigerum* released from *M. leuckarti* showing head-bulb with transverse rows of spines, lips, gut and cervical sacs. *c.s.*—cervical sac; *g.*—gut; *h.b.*—head-bulb; *lp.*—lip.

Hills and Moore Market area, bred in glass jars and utilized for infection experiments. They were screened under the microscope for any natural infection, prior to the experiments, and only infection-free individuals were left in square wells, four to six with 40 to 60 larvæ. It needs to be stressed that no natural infection was ever encountered among those collected.

Ingestion of larvæ by the copepods could not be observed under the microscope, but actively wriggling, exsheathed larvæ up to 15 in each, could be discovered in the body-cavity of the cyclops as early as 20 hours. Differentiation of a head-bulb, with the characteristic armature of 4 transverse rows of spines, and an increase in the thickness of the body were observed. Fully developed second-stage larvæ, not more than 8 in each showing 4 cervical sacs, gut, and well developed head-bulb with four rows of spines and distinct lips (Figs. 2 *a*, *b* and 3) were seen in 8 to 10 days. They measured 354 × 50 μ, and the spines numbered 36, 38, 40 and 42 in the first, second, third and fourth rows respectively, those of the second and third rows being larger and of the fourth row smaller than those of the first row. The cuticle was also clothed with spines which gradually diminished in size towards the posterior end.

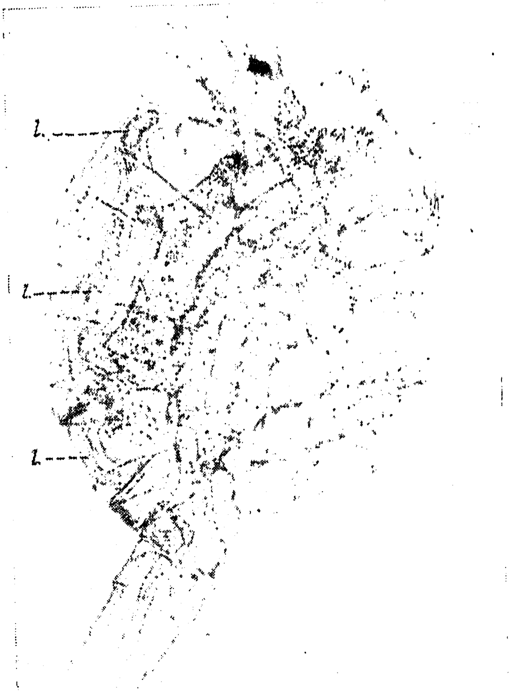


FIG. 3. Second stage larvæ of *G. spinigerum* in the body cavity of *Mesocyclops leucarti*. *l*—larva.

The cyclops which were successfully infected in the present studies were identified as *Mesocyclops leuckarti* Claus, 1857 on the basis of the 1st antenna possessing 17 segments and the presence of a hyaline membrane in its terminal segment. For further development, freshwater fishes obtained from the Madras Fisheries Department and other sources were employed. Six specimens of *Rasbora daniconius* and two of *Tilapia mossambica* were reared in an aquarium, fed with 2 or 3 infected cyclops containing second stage larvæ. Dissection of one *R. daniconius* which died on the 8th day, and all the others in the sixth week after feeding revealed no evidence of infection with *G. spinigerum*. The second intermediate host (fish) of the parasite in this part of the country still remains to be identified.

The syndrome 'Creeping eruption' or 'Cutaneous Larva Migrans' attributed to the wandering larva of *G. spinigerum* in the tissues of man has been unknown in Madras and neighbouring states. The consumption of raw or ill-cooked fish is relatively scarce in these areas and should partly explain this fact. However, the epidemiology of the infection as a zoonosis cannot be fully understood till the fish intermediate host is determined and its role as a food fish investigated thoroughly.

Grateful acknowledgement is made of the facilities given by the Dean, Madras Veterinary College, for the work which formed part of a thesis for the M.V.Sc. Degree of the University of Madras, submitted by the first author.

---

1. Alwar, V. S. and Lalitha, C. M., *Indian vet. J.*, 1958, **35**, 292.
2. Chandler, A. C., *Indian J. med. Res.*, 1925 *a*, **13**, 213.
3. — *Parasitology*, 1925 *b*, **17**, 237.
4. Maplestone, P. A., *Indian. med. Gaz.*, 1929, **64**, 610.
5. — and Bhaduri, N. V., *Ibid.*, 1937, **72**, 713.
6. — Rao, S. S., *Ibid*, 1939, **74**, 479.
7. Mitter, S. N., *J. trop. Vet. Sci.*, 1910, **15**, 284.
8. —, *Vet. Jl*, 1912, **68**, 687.
9. Miyazaki, I., *Exp. Parasit.*, 1960, **9**, 338.
10. Mukerji, A. K. and Bhaduri, N. V., *Indian med. Gaz.*, 1945, **80**, 126.
11. Prommas, C. and Daengsvang, S., *J. Parasitol.*, 1933, **19**, 287.
12. — and —, *Ibid.*, 1936, **22**, 180.
13. — ahd —, *Ibid.*, 1937, **23**, 115.
14. Rao, S. R. and Kulkarni, V. G. P., *Bombay vet. Coll. Magazine*, 1964, **11**, 1.
15. Refuerzo, P. G. and Carcia, E. Y., *Phil. J. Anim. Ind.*, 1938, **5**, 351.
16. Varma, A. K., *Curr. Sci.*, 1955, **24**, 57.

ON *BACOPA FLORIBUNDA* (R. Br.) WETTST.—A LITTLE KNOWN FLOWERING PLANT IN THE INDIAN FLORA

T. RAJAGOPAL AND N. RAMAYYA
Department of Botany, Osmania University, Hyderabad-7 (A.P.), India

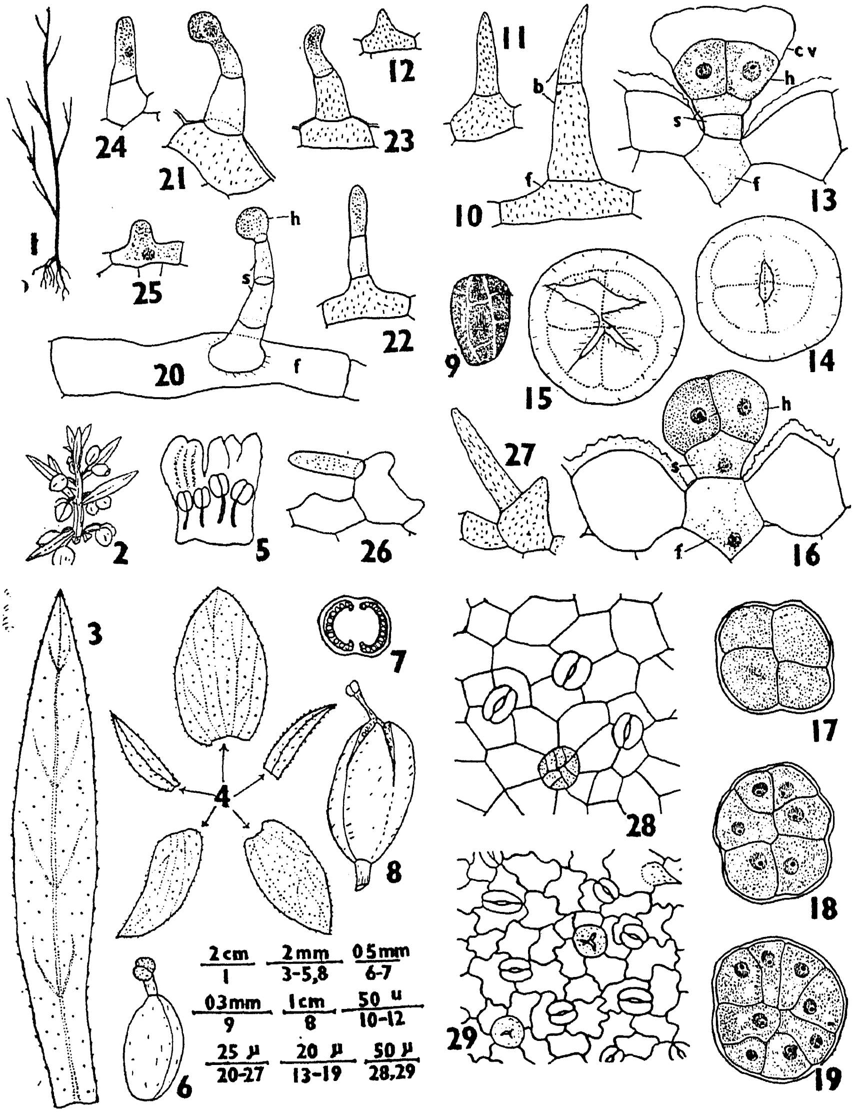
BACOPA FLORIBUNDA (R. Br.) Wettst. (Scrophulariaceæ), which is otherwise known from Africa, Java and Australia, has been so far recorded only from S. Kanara, Nellore, Chingleput in India.[2,3] Cooke[1] doubted its occurrence in the erstwhile Bombay State, whereas Santapau[4] records it from the same State without citing a locality. Besides these few reports, the present authors are not aware of its record from any other place in India. The plant has been recently collected by us from Hyderabad, which is obviously significant. Since the species has so far been neither fully described nor illustrated in the Indian floras, it was felt to fill this gap. The present paper also includes a detailed account of the various types of trichomes occurring on the different parts of the species and also the epidermal features of its leaf, due to their growing taxonomic importance.

Bacopa floribunda (R. Br.) Wettst. in *Eng. Prn. Pfam*, 4 (3 b): 77, 1895; Pennell, *Proc. Acad. Nat. Sci. Philad.*, 98: 92, 1943; Santapau, *J. Bombay Nat. Hist. Soc.*, 49: 43, 1950.

Herpestis floribunda R.Br. Prodr., 442, 1810; Hook.f., *F.B.I.*, 4: 273, 1884.

Monniera floribunda Cooke, *Fl. Pres. Bombay*, 2: 286, 1904; Gamble, *Fl. Pres. Madras*, 2: 953, 1921.

Erect herb, growing upto 10 cm (25 cm) high (Fig. 1). Stems obtusely four-angled, often branched, with glandular hairs which in herbarium specimens appear like bright dots. Leaves subsessile, 1-3 × 0·2-0·5 cm, opposite, linear or linear-lanceolate, acute, tapering at base, entire ; lamina punctate due to the shining glandular hairs (Fig. 3). Flowers nearly in the axil of every leaf, 1-3, often 2 in each axil (Fig. 2). Pedicels 3-5 mm long. Bracteoles subulate, just below the calyx, puberulous, 2-3 mm long. Calyx 5-fid upto the base (Fig. 4), puberulous. Sepals unequal in size ; the posterior largest, 5-6 × 4-5 mm, ovate oblong ; the two lateral ones narrow, linear-lanceolate. Corolla white, 3-4 mm long, upper lip with purple lines inside (Fig. 5). Stamens 4, included, epipetalous, attached just above the



FIGS. 1–29. *Bacopa floribunda*. Fig. 1. Habit (diagrammatic) showing mere branching. Fig. 2. A branch showing axillary flowers. Fig. 3. A leaf. Fig. 4. Calyx. Fig. 5. Corolla with stamens. Fig. 6. Gynœcium. Fig. 7. T.S. ovary. Fig. 8. Fruit showing apical dehiscence into four valves. Fig. 9. A seed. Figs. 10–12. Uniseriate conical hair showing gradual reduction into papillæ. Figs. 13-15. Uniseriate vesicular peltate hair: Fig. 13, L.S., Figs. 14 and 15. top view showing the breaking of the cuticular vesicle. Figs. 16–19. Uniseriate peltate hair: Fig. 16. L.S., 17–19. top view showing 4–8-celled condition of the head. Figs. 20–25. Uniseriate capitate hair: Figs. 21–23. transition towards conical hair; Figs. 20, 24 and 25. gradual reduction into papillæ. Figs. 26–27. Abnormal forms between Figs. 20 and 10. Fig. 28. Adaxial leaf epidermis. Fig. 29. Abaxial leaf epidermis. (*b*, body: *cv*, cuticular vesicle; *f*, foot; *h*, head; *s*, stalk.)

base, didynamous. Ovary ellipsoid, locules two, each with numerous ovules (Fig. 7); style short with rounded and slightly bilobed stigmas (Fig. 6). Fruit ellipsoid, dehiscing at the top into four valves (Fig. 8). Seeds numerous, small, obovate, brown to black with reticulate ridges, about 0·5 mm long (Fig. 9).

TRICHOMES

1. *Uniseriate vesicular peltate hair*: Foot: Unicellular, usually intruding beyond the epidermis. Stalk: Uniseriate, 1-2-celled; cells broader than long; walls thin, contents translucent. Head: Four-celled, circular in outline as seen from above, glandular; cells juxtaposed, nearly isodiametrical, thin-walled; contents dense. Cuticular vesicle thin, usually splitting from the centre towards the periphery. Distribution: Leaf, stem, pedicel, sepals, corolla and ovary (Figs. 13-15).
2. *Uniseriate peltate hair*: As in the above but the foot not deeply intruded; stalk usually 1-celled; head usually 4-celled (occasionally upto 10-celled), glandular, without a cuticular vesicle. Distribution: As that of the above (Figs. 16-19).
3. *Uniseriate conical hair*: Foot: Usually 1-celled. Body: 1-3-celled, tapering above; cells usually longer than broad. Walls thickened, surface with cuticular ridges; contents translucent. Distribution: Leaf, stem, pedicel, bracteoles and sepals (Figs. 10, 11).
4. *Uniseriate capitate hair*: Foot: Usually 1-celled. Stalk: Uniseriate 1-3-celled, tapering above; cells longer than broad; walls thin, smooth; contents translucent, but the terminal cell may be with relatively dense contents. Head: Spherical, 1-celled, glandular; wall thin, smooth; contents usually dense or thinner (on corolla). Distribution: Sepals, corolla (Figs. 20-25).

VARIATIONS IN TRICHOMES

The uniseriate conical hairs become progressively shortened and appear like short unicellular papillæ on the sepals (Fig. 10–12). Besides they also merge, on the sepals, into uniseriate capitate hairs through intermediate forms as shown in Figs. 22, 23.

The uniseriate capitate hair also shows variation on the sepals due to reduction and appears like short unicellular papillæ (Figs. 20, 24, 25); at this stage the papillate forms of both the uniseriate conical hair and the uniseriate capitate hair become indistinguishable.

Both the above hair types are also characterised by yet another variation on the sepals. In either case, occasionally structural aberrations occur and are represented by bizarre forms as shown in Figs. 26, 27.

FOLIAR EPIDERMIS

Stomata: Predominantly anomocytic, some anisocytic, few with three equal subsidiary cells. Few stomata contiguous along sides, some with one or both the guard cells aborted. Distribution: Irregular, bifacial. Frequency per square millimetre: adaxial 25-100, average 60; abaxial 100-175, average 130 (Figs. 28, 29).

Epidermal cells: Polygonal, surface smooth; cells of the adaxial side with straight to curved walls (Fig. 28), of the abaxial side with wavy to sinuate walls; sinuses U-shaped (Fig. 29).

Trichomes: 1-3 trichome types described above present on both the surfaces (Figs. 10, 13, 16).

ECOLOGY AND DISTRIBUTION

Growing along with *Drosera burmanni*, *D. indica*, *Rotala illecebroides*, *Xyris* sp., *Utricularia* spp., grasses and sedges, in marshy spots. Flowers and fruits: November to January.

India: Nellore, Chingleput, S. Canara and Hyderabad (Thumalla kunta, *Rajagopal* 650, deposited at Herbarium Bot. Dept., Osmania University, Hyderabad). Tropical Africa, Australia and Java.

In the light of the habitat conditions in which the species has been presently collected, the authors consider that it may really be widespread in distribution in India, but it should be looked for in habitats where the above-mentioned associate species occur. Paucity of its previous record might thus be due to its preference to a specialised habitat and also its insignificant size.

ACKNOWLEDGEMENTS

We are deeply indebted to Prof. M. R. Suxena for encouragement and facilities. We are also thankful to the A. P. Akademi of Sciences for financing the project. One of the us (T. R.) is thankful to the CSIR for the award of a Senior Research Fellowship.

---

1. Cooke, T., *Flora of Presidency of Bombay*, 1904, **2**, 286.
2. Gamble, J. S., *Flora of Presidency of Madras*, 1921, **2**, 953.
3. Hooker, J. D., *Flora of British India*, 1884, **4**, 273.
4. Santapau, H., *J. Bombay Nat. Hist. Soc.*, 1950, **49**, 43.

LETTERS TO THE EDITOR

ON THE RAYLEIGH'S FLOW PAST AN INFINITE POROUS PLATE

In discussing the Rayleigh's flow[1] past an infinite flat plate in the presence of a transverse magnetic field, we assumed the fluid to be a weakly conducting one, enabling us to neglect the induced magnetic field. This case corresponds to the magnetic Prandtl number $P_m = 0$. We now remove this restriction; but assume $P_m = 1$. In this case it is interesting to note that the hydromagnetic equations[2] become uncoupled by means of a simple substitution. The equations governing the Rayleigh's flow we studied earlier, are

$$\frac{\partial u}{\partial t} = \nu \frac{\partial^2 u}{\partial y^2} + \frac{\mu H_0}{\rho} \frac{\partial h_x}{\partial y}, \tag{1}$$

$$\frac{\partial h_x}{\partial t} = H_0 \frac{\partial u}{\partial y} + \frac{1}{\mu\sigma} \frac{\partial^2 h_x}{\partial y^2}. \tag{2}$$

The initial and boundary conditions are

$$\begin{aligned} t \leq 0:&\ u = h_x = 0 \ \text{ for } \ y \geq 0, \\ t > 0:&\ u = U_0, = 0 \ \text{ for } \ y = 0, \\ &u,\ h_x \text{ are finite for } y \to \infty. \end{aligned} \tag{3}$$

Using the dimensionless variables

$$\phi = \frac{u}{U_0},\ \eta = \frac{yU_0}{\nu},\ \tau = \frac{U_0^2\, t}{\nu},\ \psi = \frac{h_x}{H_0}, \tag{4}$$

and the substitutions

$$\xi = \phi + \alpha\psi,\ \chi = \phi - \alpha\psi, \tag{5}$$

wherein α is the Hartmann number[1] and Prandtl number $P_m = \mu\sigma\nu$ is taken to be unity, the equations (1) and (2) are uncoupled into two differential equations in ξ and χ

$$\frac{\partial \xi}{\partial \tau} = \alpha \frac{\partial \xi}{\partial \eta} + \frac{\partial^2 \xi}{\partial \eta^2}, \tag{6}$$

$$\frac{\partial \chi}{\partial \tau} = -\alpha \frac{\partial \chi}{\partial \eta} + \frac{\partial^2 \chi}{\partial \eta^2}. \tag{7}$$

The conditions on ξ are

$$\xi(0, \eta) = 0,\ \xi(\tau, 0) = 1,\ \xi(\tau, \infty) < \infty \tag{8}$$

Solving (6) subject to (8) by the Laplace transform technique, we get

$$\phi = \frac{1}{2} \cosh \frac{\eta\alpha}{2} \left[e^{\eta\alpha/2} \operatorname{erfc} \left\{ \frac{\eta}{2\sqrt{\tau}} + \frac{\alpha\sqrt{\tau}}{2} \right\} + e^{-\eta\alpha/2} \operatorname{erfc} \left\{ \frac{\eta}{2\sqrt{\tau}} - \frac{\alpha\sqrt{\tau}}{2} \right\} \right], \tag{9}$$

$$\psi = -\frac{\phi}{\alpha} \tanh \frac{\eta\alpha}{2}. \tag{10}$$

The broken (or continuous) lines in Fig. 1 represent the non-dimensional velocity profile θ *versus* η, when the induced magnetic field is neglected (or not neglected). A study of the figure and calculations for various values of α, show that the velocity at any point of the fluid gets increased when the induced magnetic field is taken into consideration. The induced magnetic field is also shown in Fig. 1.

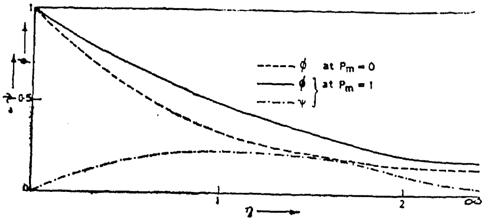


FIG. 1. Plots of ϕ and ψ *versus* η at $\tau = 1$ for $\alpha = 1$.

The effect of a uniform suction at the plate can be included in the above analysis.

Dept. of Applied Mathematics, Andhra University,
Waltair, *November* 19, 1969.

V. VIDYANIDHI.
V. V. RAMANA RAO.

---

1. Vidyanidhi, V. and Ramana Rao, V. V., *Curr. Sci.*, 1968, **37**, 427.
2. Sutton, G. W. and Sherman, A., *Engineering Magnetohydrodynamic*, McGraw-Hill, 1965, p. 361.

FORCE FIELD, MEAN SQUARE AMPLITUDES OF VIBRATION AND CORIOLIS COUPLING COEFFICIENTS OF SULPHUR MONOHALIDES

ABSTRACT

On the basis of general valence force field a set of force constants has been obtained for S_2Cl_2 and S_2Br_2. Generalised mean square amplitudes of vibration for both bonded and non-bonded atom pairs and the Coriolis coupling coefficients have also been evaluated. The significance of the values obtained has also been discussed.

SPECTROSCOPIC study of sulphur monohalides dates back from 1930's. But the structure of these molecules was established to be that of the right angle model of H_2O_2 with C_2 symmetry only in 1958, from an electron diffraction study of them by E. Hirota.[1] He reassigned the frequencies of sulphur monochloride and monobromide and carried out a normal co-ordinate analysis on the basis of Urey-Bradley force field. Recently, the infrared spectrum of S_2Br_2 [2] and infrared and Raman Spectra of S_2Cl_2 [3] have been reinvestigated and new assignments have been given. In the present investigation the force constants of S_2Br_2 and S_2Cl_2 have been determined (Table I) on the basis of general valence force field using F-G matrix method.[4] The internal co-ordinates employed in the construction of the symmetry co-ordinates are as shown in Fig. 1. The structural parameters used are taken from Reference 1.

TABLE I

Values of force constants (md/Å)

Force constants	S_2Cl_2	S_2Br_2
f_R	2·50	2·50
f_r	1·99	1·43
f_α	0·28	0·26
f_β	0·05	0·04
f_{Rr}	0·12	0·12
f_{rr}	0·12	−0·14
$f_{\alpha\alpha}$	0·02	0·02
$f_{r\alpha}$	0·08	0·08
$f_{r\alpha}'$	−0·01	0·01

Generalised mean square amplitudes of vibration of both bonded and non-bonded atom pairs are also computed[5] and are given in Table II. In sulphur monohalides Jahn's rule[6] permits A × B coriolis coupling corresponding to ζ^x and ζ^y. These coriolis coupling coefficients are determined[7] and the values are given in Table III.

The values of most of the force constants in the present investigation of S_2Br_2 agree with the values of Bradley *et al.*[2] Two more interaction constants $f_{rr} = -0·14$ md/Å and $f_{\alpha\alpha} = 0·02$ md/Å are found to be significant.

The calculated values of the parallel mean amplitudes of vibration of the bonded and non-bonded atom pairs in S_2Cl_2 and S_2Br_2 are compared with those obtained from electron diffraction[1] in Table IV. The agreement is fairly good, except for Br....Br pair, indicating the set of force constants selected to be the most probable one. For Br....Br atom pair the electron diffraction value is only a rough estimate. The discrepancy may also be due to the decomposition of sulphur monobromide into sulphur and bromine and the resulting contamination of sulphur monobromide with bromine.

TABLE II

Generalised mean square amplitudes of vibration (10^{-4} Å^2)

Molecule	Atom pair	Distance Å	Parallel vibration $(\Delta z)^2$	Perpendicular vibration $(\Delta x)^2$	$(\Delta y)^2$	Mean cross products $(\Delta z \cdot \Delta x)$	$(\Delta z \cdot \Delta y)$	$(\Delta x \cdot \Delta y)$
S_2Cl_2	S — Cl	2·07	28·71	56·96	146·10	−4·00	− 1·74	49·85
	S — S	1·97	24·34	42·15	70·07	0	5·73	0
	S ... Cl	3·25	77·90	32·85	95·94	−4·97	−17·18	46·36
	Cl...Cl	4·12	255·80	7·97	28·81	0	−43·32	0
S_2Br_2	S — Br	2·24	35·68	57·30	175·00	−2·87	− 0·44	69·05
	S — S	1·98	24·16	54·32	97·98	0	5·93	0
	S ... Br	3·35	85·80	46·71	114·80	2·97	−21·37	56·64
	Br ... Br	4·26	296·30	4·21	11·22	0	−41·97	0

TABLE III

Coriolis coupling coefficients

	ζ^x			ζ^y	
	S_2Cl_2	S_2Br_2		S_2Cl_2	S_2Br_2
$\zeta_{1,5}$	−0·0434	−0·0566	$\zeta_{1,5}$	−0·5643	−0·7231
$\zeta_{2,5}$	−0·0740	−0·2017	$\zeta_{2,5}$	−0·2262	−0·0556
$\zeta_{3,5}$	0·6120	0·7764	$\zeta_{3\ 5}$	0·1322	0·0291
$\zeta_{4,5}$	0·7139	0·5619	$\zeta_{4,5}$	−0·3509	−0·2324
$\zeta_{1,6}$	−0·0266	0·0241	$\zeta_{1,6}$	0·7117	0·5322
$\zeta_{2,6}$	0·3868	0·5136	$\zeta_{2,6}$	−0·1414	−0·4977
$\zeta_{3,6}$	−0·3747	−0·1666	$\zeta_{3,6}$	−0·1340	−0·3063
$\zeta_{4,6}$	0·1049	0·2568	$\zeta_{4,6}$	−0·5104	−0·4625

TABLE IV

Mean amplitudes of vibration

Molecules	Atom pair	Calculated Å	Observed Å
S_2Cl_2	S — Cl	0·054	0·05+0·01
	S — S	0·049	0·05+0·03
	S... Cl	0·088	0·08+0·02
	Cl...Cl	0·160	0·14+0·07
S_2Br_2	S — Br	0·060	0·0 +0·015
	S — S	0·049	0·05 (assumed)
	S... Br	0·093	0·09+0·02
	Br...Br	0·173	0·31 (~)

The f_r force constant is found to be decreasing with the higher halogen substitution whereas the corresponding parallel mean amplitude increases.

In the puckered rings of S_8 and S_6 molecules each sulphur atom uses approximately sp^3 hybridised tetrahedrally arranged orbitals. The S-S-S angles in S_8 and S_6 are 108° and 102·2° which are close to the S-S-Cl angle of 107° in S_2Cl_2 and the S-S-Br angle of 105° in S_2Br_2. The presence of lone pair electrons effect a decrease in bond angles from the tetrahedral value. The value of 2·5 md/Å has been obtained for the S-S force constant in both the molecules. This value agrees well with the values of 2·37 md/Å and 2·40 md/Å in S_8[8] and S_6.[9] The S-S-Y bending force constant in S_2Cl_2 and S_2Br_2 has values 0·28 md/Å and 0·26 md/Å and they are in order with the values of bending force constant 0·234 md/Å and 0·242 md/Å estimated for S_8 and S_6. This confirms that in S_2Y_2 molecules each sulphur atom uses approximately sp^3 hybridised orbitals and the angular arrangement is similar to the puckered rings in S_8 and S_6.

The lengths of S-S bond in S_2Cl_2 and S_2Br_2 are 1·97 Å and 1·98 Å and in S_8 and S_6 are 2·060 Å and 2·057 Å.[9] There is a small contraction in the length of S-S bond which is in agreement with the fact that when an electronegative atom is substituted the adjacent bond is shortened.[10] But a significant increase in the S-S force constant is not obtained in S_2Cl_2 and S_2Br_2.

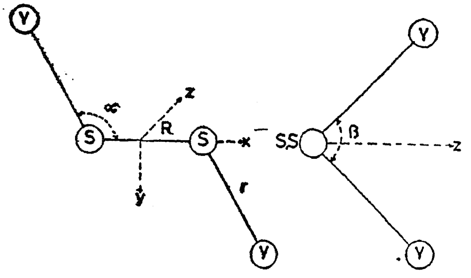


FIG. 1. Molecular geometry and internal co-ordinates.

We thank Prof. K. Venkateswarlu for his kind interest in the progress of the work. One of us (V. U. N.) is grateful to the C.S.I.R., New Delhi, for the award of a Junior Research Fellowship.

Dept. of Physics, V. UNNIKRISHNAN NAYAR.
Kerala University G. ARULDHAS.
Centre, Ernakulam,
Kerala, *November* 17, 1969.

---

1. Hirota, E., *Bull. Chem. Soc. Japan*, 1958, **31**, 130
2. Bradley, E. B., Bonnet, C. R. and Jones, E. A., *Spectrochim. Acta*, 1965, **21**, 1505.
3. —, Mathur, M. S. and Frenzel, C. A., *J. Chem. Phys.* 1967, **47**, 4325.
4. Wilson, E. B., Jr., *Ibid.*, 1939, **7**, 1047.
5. Morino, Y. and Hirota, E., *Ibid.*, 1955, **23**, 737.
6. Jahn, H. A., *Phys. Rev.*, 1939, **56**, 680.
7. Meal, J. H. and Polo, S. R., *J. Chem. Phys.*, 1956, **24**, 1119.
8. Scott, D. W., McCullough, J. P. and Kruse, E. H., *J. Mol. Spectry*, 1964, **13**, 313.
9. Berkowiz, J., Chupka, W. A., Bromels, E. and Belford, R. L., *J. Chem. Phys.* 1967, **47**, 4320.
10. Bent, H. A., *Ibid.*, 1960, **33**, 1259.

USE OF PLATINUM WARE IN THERMOGRAPHY

THE thermal behaviour of most substances will differ very little with respect to the type of containers commonly used, namely, sintered alumina and platinum ware. However, we wish to point out that platinum, in cases where it can exhibit its catalytic activity, may modify to an appreciable extent the thermal characteristics of a system and this should be taken into account in the interpretation of the thermal data. As an illustration, we report our observations on the dependence of the thermogravimetric behaviour of zinc sulphide in air on the type of container used.

Exactly 0·5 g samples of finely powdered (– 200 mesh) pure zinc sulphide were heated in alumina or platinum crucibles at a linear rate of 6° per minute in air from ambient temperature to 1,100° C. The dimensions of both types of crucibles were: height 21 mm, diameter at top 16–17 mm and at bottom 8–9 mm. The weight *versus* temperature recordings were made using a Stanton Model HT-SM recording thermobalance. In Fig. 1 are plotted the variation of weight per cent of material in the crucible (calculated with respect to the amount

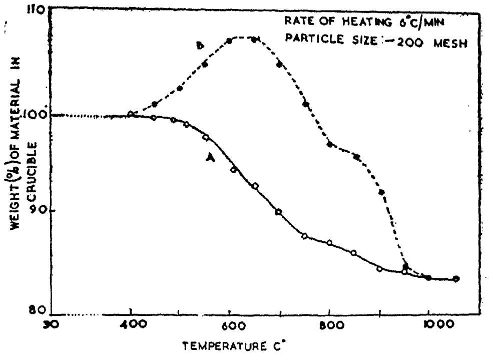


FIG. 1. Thermogram of ZnS in air. (A) Alumina crucible; (B) Platinum crucible.

of zinc sulphide taken) with temperature. To aid in the interpretation of the results, the thermogravimetric runs were interrupted in many experiments at desired temperatures and the materials in the crucibles were identified by chemical and X-ray methods. It could be seen that the thermograms as obtained in the two types of crucibles differ greatly. When alumina crucibles were used, there was continuous decrease in weight of material from about 450° to 1,100° C; examination of the material in the range 500-1,000° showed it to be comprised predominantly of zinc sulphide and zinc oxide, with the latter increasing in proportion with increase in temperature. Only very small amounts of zinc sulphate (maximum of about 1%) were found, which were determined by treating the sample with known amount of excess barium chloride, and the unconsumed barium chloride was titrated with EDTA using Solochrome Black T as indicator.[1] In contrast to the behaviour in alumina crucibles, when platinum crucibles were used there was a significant increase in the weight of material with respect to amount of zinc sulphide taken in the temperature range 400-780°, featured by a maximum at about 620°; in addition to zinc sulphide and zinc oxide, large amounts of zinc sulphate (maximum about 20% by weight at 620°) were found to be present in this temperature range. Beyond 780°, the percentage of ZnO increased at the expense of both ZnS and $ZnSO_4$ and as in the experiments done using alumina crucibles, at 1,100°, the final product was pure ZnO.

The results obtained could be explained as follows: the formation of zinc oxide on heating the sulphide in air occurs *via* the scheme of reactions:

$$ZnS + \frac{3}{2} O_2 \rightarrow ZnO + SO_2 \qquad (1)$$

$$SO_2 + \frac{1}{2} O_2 \rightleftharpoons SO_3 \qquad (2)$$

$$ZnO + SO_3 \rightarrow ZnSO_4$$

(at moderate temperatures) (3)

$$ZnS + ZnSO_4 \rightarrow 2\,ZnO + 2\,SO_2 \qquad (4)$$

and

$$ZnSO_4 \rightarrow ZnO + SO_3$$

(at higher temperature *via* formation of the phase $ZnO \cdot 2\,ZnSO_4$) (5)

When alumina crucibles are used, the formation of SO_3 *via* (2) is very limited but when platinum crucibles are used, reaction (2) is catalysed by the platinum surface and the formation of SO_3 and hence of zinc sulphate is extensive. This changes the thermogram of the system as seen in Fig. 1. The catalytic activity of platinum could also affect the thermographs of some systems studied by other thermoanalytical techniques. Thus, Liptay *et al.*[2] have reported that use of platinum holders in the differential thermal analysis of ammonium compounds, such as $MgNH_4PO_4 \cdot 6\,H_2O$, caused difficulties due to the platinum catalysed oxidation of ammonia by air.

Dept. of Chemistry, M. Ramakrishna Udupa.
Indian Inst. of Tech., G. Aravamudan.
Madras-36, *November* 12, 1969.

---

1. Sijderius, R., *Anal. Chim. Acta*, **1954, 10, 517.**
2. Liptay, G., Berenyi, M. and Sarkany, E., *Hung. Sci. Insts.*, **1968, 15, 31.**

THE CHEMICAL CONSTITUENTS OF THE OIL FROM THE FRUIT OF *SEMECARPUS ANACARDIUM*

The marking nut (*Semecarpus anacardium* Linn.) is well known for its vesiceant liquid which causes severe burns and allergic œdema in exposed parts such as face and hands. Nevertheless, the marking nut finds frequent application in Indian medicine in the treatment of gout, rheumatic pains and other ailments. It is even reported in recent years as an anti-cancer drug. Pillay and Siddiqui[1] isolated a phenolic liquid which they named bhilawanol and regarded it as a catechol derivative with $C_{15}H_{27}$ chain (I).

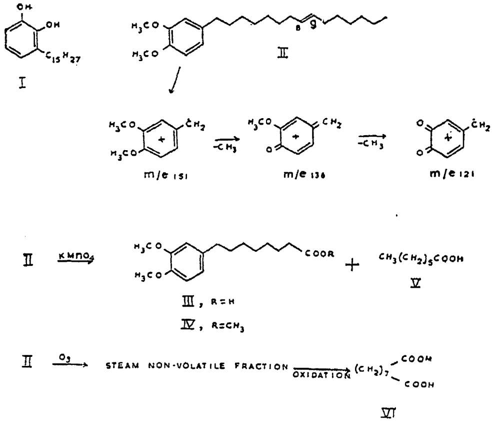
During a reinvestigation of this nut, the unstable phenolic oil was completely methylated with dimethyl sulphate and potassium carbonate in acetone medium. Methylation with diazomethane yielded only partially methylated oil. The methylated oil distilled under vacuum (Fraction A: B.P. 156°/2·3 × 10^{-3} mm.; Fraction B B.P. 188–90°/2·3 × 10^{-3} mm.). Both these fractions showed three to four spots on T.L.C. (silicagel impregnated with silver nitrate; solvent: benzene: *n*-hexane (1 : 1). The Iodine value of the crude methyl ether (B.P. 196–8°/1 mm.) suggested three double bonds of an overall unsaturation. The mass spectrum of this methylated oil (B. P. 196–98°/1 mm.) gave evidence for four molecular ion peaks at M^+ 344, 346, 356 and 358, of which the major peak is at M^+ 346 confirmed by G.L.C. on a PEGH column using nitrogen.

Effective separation of this mixture was achieved on silicagel impregnated with 30% silver nitrate. Elution with Benzene: *n*-hexane (1 : 3) afforded colourless oil (Fraction I; B.P. 205°/1 mm.; yield: 70%). The remainder gave two fractions (Fractions II and III) in equal proportion (about 10%).

Fraction I (Structure II) was oxidised with neutral permanganate and the products separated by steam distillation. The steam volatile acid was identified to be *n*-heptanoic acid (V). The non-volatile acid was a liquid aromatic acid isolated as its methyl ester (B.P. 182-84°/1·5 mm.) (IV).

Ozonolysis of Fraction I (II) was carried out for 14 hours, and the non-volatile oil fraction was oxidised by passing a current of air. From the resulting mixture a small quantity of azelaic acid was secured, identified by comparison with an authentic sample (m.m.p. and N.M.R.).

The structure of the non-volatile aromatic acid was established as 8-(3 : 4-dimethoxyphenyl)-octanoic acid (III) by a study of N.M.R. and Mass spectra of its methyl ester (IV). In the mass spectrum, the mass peak at M^+ 294 clearly confirms the molecular formula $C_{17}H_{26}O_4$. The fragmentation peaks at m/e 151, 136 and 121 are assignable to the fragments shown below. The ratio of the two peaks at 151/152 is about 1 : 2 and similar to that for an unsubstituted alkylbenzene indicating that there is some *meta*-stabilisation of m/e 152.[2] This larger ratio is supported only when the methoxyls are placed at 3 : 4- ; the *meta*-methoxyls make the peak m/e 152 larger and hence the ratio would be smaller than one. The mass spectrum, therefore, excludes the *meta*-methoxyls and confirms the structure IV for the methyl ester.



The N.M.R. spectrum also confirms the structure IV for the ester ; the two signals at τ 6·26 and 6·2 relate to 3 : 4-methoxyls and the remaining three aromatic protons appear as two *ortho*-coupled protons ($\tau_{5,6} = 9$ cps) and two *meta*-coupled protons ($J_{2,6} = 3$ cps).

Thus the two oxidation products, 8-(3 : 4-dimethoxyphenyl)-octanoic acid (III) and *n*-heptanoic acid (V) suggest that the Fraction I might have the structure II (M^+ 346, $C_{23}H_{38}O_2$) with double bond between C_8 and C_9. Its fragmentation pattern is similar to that of the methyl ester (IV). The three peaks at m/e 151, 136 and 121 arise out of the aromatic portion. The N.M.R. spectrum also confirms the structure II, for fraction I, which is thus, penta dec-Δ^8-amyl (3, 4 dimethoxy) benzene. It has one methyl group at τ 9·17 (T). The olefinic protons occur as a triplet (τ 4·65–4·73–4·82). The signals of aromatic protons coincide exactly with those of methyl ester (IV).

Finally, the origin of azelaic acid (VI) remains to be explained. It may be that the benzene ring system is getting decomposed through its ozonide and azelaic acid is possible only if the double bond is situated at 8–9 position, thus indirectly confirming the structure II for Fraction I.

The N.M.R. spectrum of Fraction II (M^+ 344) differed significantly from Fraction I (II). The olefinic protons (triplet ; τ 4·52-4·6–4·69 ; J = 17 cps) integrate for 4 *trans*-coupled olefinic protons and suggest two double bonds in this fraction. The methyl signal is centred around τ 9·11 (T) and the aromatic methoxyls (τ 6·18 and 6·15) and the aromatic protons are exactly similar to those of Fraction I (II).

Many of the well-known properties of marking nut oils are easily explainable by the catechol half and lipoid-soluble C_{15} chain. During exposure to air, the catechol ring might be oxidised to an orthoquinone which might impart the dark colour and also encourage polymerisation. The vesiccant nature and the indelible pigmentation may be closely connected with the rapid formation of the orthoquinonoid intermediate. The absorption of the oil by the skin is obviously due to the lipoid-soluble C_{15} chain.

We are greatly indebted to the Indian Council of Medical Research, New Delhi, for financing the investigation, and to Dr. R. T. Brown, Manchester University, for N.M.R. and Mass spectra recorded in this investigation.

Dept. of Chemistry, N. S. PRAKASA RAO.
Andhra University, L. RAMACHANDRA ROW.
Waltair, *November* 20, 1969.

---

1. Pillay, P. P. and Siddiqui, S., *J. Ind. Chem. Soc.*, 1931, **3**, 517.
2. Occolowitz, *Anal. Chem.*, 1964, **36** (11), 2177.

DETERMINATION OF XANTHATES AND DITHIOCARBAMATES WITH POTASSIUM IODATE

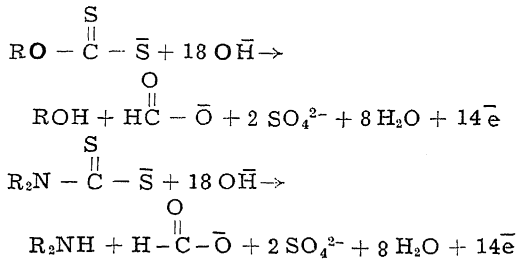
XANTHATES and dithiocarbamates are important sulphur compounds having wide applications. The former are used as collectors in oil flotation of ores, in rayon industry, etc., while the latter find application as vulcanisation accelerators, fungicides, etc. Their determination is, therefore, of much interest. Oximetric methods employing chloramine-T have been developed for xanthates[1] and dithiocarbamates.[2] In this communication, analytical procedures are described for these compounds using a more common oxidant, potassium iodate.

Reagents : B.D.H. AnalaR potassium iodate was employed. Standard solutions were prepared by dissolving a known amount in water. Potassium ethylxanthate (Reidel de Häen) and sodium diethyldithiocarbamate (BDH AnalaR) were used to prepare their standard solutions and their strengths were checked by the chloramine-T procedures.[1,2] Other reagents used were all of analytical reagent grade.

Procedure : The oxidations were carried out under a variety of conditions. It was found that oxidation in an acidic or alkaline medium was not satisfactory at room temperature. However, excellent results were obtained at higher temperatures. The recommended procedure is given below.

Measured aliquots (25 ml.) of potassium iodate solutions were pipetted into stoppered 500 ml. conical flasks and made alkaline with 5 ml. 5 N sodium hydroxide. Into this, measured aliquots of the standard xanthate (or dithiocarbamate) solution were added. The solution was boiled for half-an-hour. After cooling to room temperature, the unconsumed iodate was iodometrically estimated as usual. Blanks were run concurrently; no blank corrections, however, were necessary.

Typical results are presented in Table I. It may be seen that 14 equivalents of the oxidant are consumed per mole of the xanthate as well as the dithiocarbamate. This agrees with the following oxidation schemes :



$$RO-\overset{S}{\overset{\|}{C}}-\bar{S}+18\,O\bar{H}\rightarrow$$

$$ROH+H\overset{O}{\overset{\|}{C}}-\bar{O}+2\,SO_4^{2-}+8\,H_2O+14\,\bar{e}$$

$$R_2N-\overset{S}{\overset{\|}{C}}-\bar{S}+18\,O\bar{H}\rightarrow$$

$$R_2NH+H-\overset{O}{\overset{\|}{C}}-\bar{O}+2\,SO_4^{2-}+8\,H_2O+14\,\bar{e}$$

TABLE I

Determination of xanthate and dithiocarbamate with potassium iodate

Expt. No.	Substance	Milli-moles of substance taken	Milli-equivalents of KIO_3 consumed	No. of mole equivalents of KIO_3 consumed per mole of substance
1	Potassium ethyl xanthate	0·1212	1·697	14·01
2	,,	0·09696	1·358	14·01
3	,,	0·1697	2·369	13·96
4	,,	0·07272	1·020	14·03
5	Sodium diethyl-dithiocarbamate	0·1086	1·530	14·09
6	,,	0·1629	2·280	14·00
7	,,	0·1901	2·661	14·00
8	,,	0·1358	1·901	14·00

Separate experiments showed that formic acid and formates are not oxidised by potassium iodate under the present experimental conditions.

Univ. Dept. of Chem., B. GOPALAKRISHNAN NAIR.
C. G. RAMACHANDRAN NAIR.
Kerala University,
Trivandrum-1, *November* 17, 1969.

1. Satyanarayana Rao, V. R. and Vasudeva Murthy, A. R., *Talanta*, 1969, **4**, 206.
2. Ramachandran Nair, C. G., Joseph, T. and Joseph, P. T., *Chemist.-Analyst*, 1965, **54**, 111.

OCCURRENCE OF 2-ACETYL-1-NAPHTHOL IN THE STEM-BARK OF *RHODODENDRON GRANDE*

IN the past decade a number of acetyl-naphthols free or combined have been isolated from natural sources. 2-Acetyl-naphthalene-1, 8-diol was isolated from the bark of *R. frangula*.[1] 2-Acetyl-3-methylnaphthalene-1, 8-diol was isolated under the name nepodin from the roots of *Rumex japonicus*[2] and the roots of *Rumex nopalensis*[3] and under the name musizin from the heartwood of *Mœsopsis eminii*,[4] its 8-0-rutinoside from the leaves of *Dianella lœvis*[5] and 8-0-glucoside from the leaves of *Rumex obtusifolius*.[6] Torachrysone obtained from the seeds of *Cassia tora* has been found to have the structure 2-acetyl-3-methyl-6-methoxy-naphthalene-1, 8-diol.[7] We report herein the isolation of a simple member of this group from the stem-bark of *Rhododendron grande* Wight. (family : Ericaceæ).

The petroleum ether extract of the bark during progressive concentration yielded solid fractions which were made up of neutral and acidic components. The combined solid fractions were taken in a large volume of ether-benzene and washed with dilute sodium hydroxide. The solid that separated at the interphase was separated and marked (A), the neutral fraction remaining in solution in the organic phase marked (B) and a phenolic fraction obtained by the neutralisation of the filtered alkaline solution marked (C).

The identity of (A), m.p. 280–82°, with ursolic acid was proved by its colour reactions and by the preparation of its acetate, m.p. 281–83°, $[\alpha]_D^{28} + 64 \cdot 0°$ (chloroform) and methyl acetyl-ursolate, m.p. 247–48°, $[\alpha]_D^{35} + 58 \cdot 0°$ (chloroform) and direct comparison of these substances with authentic samples (m.m.p., TLC and IR). The identity of (B), m.p. 202–03°, $[\alpha]_D^{35} + 82 \cdot 0°$ (chloroform) with campanulin was proved by its colour reactions, isomerisation to campanulol, m.p. 241–43°, $[\alpha]_D^{35} - 38 \cdot 8°$ (chloroform) and direct comparison with authentic samples (m.m.p., TLC and IR).

The phenolic compound (C), long pale yellow needles from acetone or alcohol, m.p. 102–04°, had the molecular formula $C_{12}H_{10}O_2$ (M^+186). It gave a monoacetate, m.p. 94–95° and a monomethyl ether, m.p. 54–56° with dimethyl sulphate and K_2CO_3 in acetone, and a mono 2 : 4-dinitrophenylhydrazone. It gave a strong green ferric colouration. The parent substance showed a chelated carbonyl absorption at 1624 cm.$^{-1}$ but its acetate showed normal carbonyl absorption at 1679 cm.$^{-1}$ (besides two bands at 1764 and 1274 cm.$^{-1}$ due to $\rangle$ C=O and C–O–C stretching vibrations respectively of the phenolic acetate). These observations indicated chelation between the OH and C=O groups. The parent compound answered the iodoform reaction. On zinc dust distillation it yielded naphthalene (m.p., m.m.p. and UV) and on oxidation with $KMnO_4$ in acetone it gave phthalic acid (m.p., m.m.p. and TLC) which on sublimation gave phthalic anhydride (m.p., m.m.p., IR and fluorescein reaction). All these data indicated that the parent compound was a naphthalene derivative in which one ring carried no substituents and the hydroxyl and acetyl groups occupied ortho-positions in the other ring. Three structures are possible for such a compound, namely, 2-acetyl-1-naphthol, 1-acetyl-2-naphthol or 2–acetyl–3–naphthol. A comparison of the m.p.s. of these three compounds (which have been known earlier as synthetic substances) with the m.p. of the compound under study showed that the substance isolated from *R. grande* is 2-acetyl-1-naphthol. The identity was proved by direct comparison with a synthetic specimen (m.m.p., TLC and IR).

The authors are grateful to Professor T. R. Seshadri for his interest.

Dept. of Chemistry, S. Rangaswami.
University of Delhi, P. Venkateswarlu.
Delhi-7, *November* 25, 1969.

---

1. Pailer, M., Jentzsch, K., Kump, W. and Fuchs, L., *Monatsh.*, 1958, **89**, 540.
2. Hesse, O., *Annalen der Chemie*, 1896, **291**, 305.
3. Murakami, T. and Matsushima, A., *Chem. Pharm. Bull. (Japan)*, 1961, **9**, 654.
4. Cowell, C. J., King, F. E. and Morgan, J. W. W., *J. Chem. Soc.*, 1961, p. 702.
5. Batterham, T., Cooke, R. G., Duewell, H. and Sparrow, L. G., *Austral. J. Chem.*, 1961, **14**, 637.
6. Bowman, R. E., Falshaw, C. P., Franklin, C. S., Johnson, A. W. and King, T. J., *J. Chem. Soc.*, 1963, p. 1340.
7. Shibata, S., Morishita, E., Kaneda, M., Kimura, Y., Takido, M. and Takahashi, S., *Chem. Pharm. Bull. (Japan)*, 1969, **17**, 454

STUDIES ON THE MOLYBDENUM (V)-KOJIC ACID COMPLEX

In continuation of our earlier work[1] on molybdenum (VI)-kojic acid complexes, we have now investigated the molybdenum (V)-kojic acid complexes.

A yellow product is obtained when molybdenum (V) and kojic acid are mixed in solutions, the intensity of the colour being maximum in 3·5 to 4·0 N hydrochloric acid medium. The yellow product can be best extracted into 60% *n*-butanol in benzene. Maximum absorbance is observed only when the reagent concentration is about 90 times that of molybdenum. The colour is stable for about one hour in aqueous medium and six hours in non-aqueous phase. A single equilibration for one minute with 60% *n*-butanol in benzene recovers only 62% of molybdenum. The complex both in the aqueous and non-aqueous phases exhibits two absorption maxima, at 360 mμ and 395 mμ. The molar absorptivities are found to be 550 in aqueous phase and 1266 in the organic phase at 395 mμ. Spectrophotometric evidence shows that both in aqueous and non-aqueous phases the complex has molybdenum and kojic acid in 1 : 1 ratio. In the organic phase two molecules of *n*-butanol are found to be associated with each complex species.

One of us (K. V. R.) thanks the Council of Scientific and Industrial Research for the award of a Research Fellowship.

Chemistry Department, A.U. Post-Graduate Centre,
Guntur-5, *November* 24, 1969.
V. Pandu Ranga Rao.
K. Venu Gopala Rao.

---

1. Pandu Ranga Rao, V. and Venu Gopala Rao, K., *Curr. Sci.*, 1968, **37**, 696.

CATION EXCHANGE CAPACITY OF SPECIFIC GRAVITY SEPARATES OF SANDS AND SILTS OF BASALTIC REGUR SOILS

In the course of a study on the genesis of basaltic regur soils of Malwa Plateau, Madhya Pradesh, it was found that the coarse fractions ($> 2\mu$) contribute to the cation exchange capacity (C.E.C.) of the soils.[1] Study on a number of soil profiles of the region has confirmed the earlier findings and it is further observed that the contribution to the C.E.C. of the soils is particularly significant in the fine sand and coarse silt fractions of the C-horizon than in the surface (Ap) horizon. Data on two typical soil profiles is presented in Table I.

TABLE I

Cation exchange capacity of the soils and their size fractions*

Soil series	Horizon	Depth (cm)	Cation exchange capacity (me/100 g)					
			Soil	Coarse sand	Fine sand	Coarse silt	Fine silt	Clay
Baloda ..	Ap	0- 10	70·5	8·1 (0·8)†	10·9 (2·5)	19·3 (3·1)	54·9 (4·9)	113·2 (88·6)
	C	115–128	41·5	8·5 (3·6)	12·9 (12·5)	21·7 (9·4)	44·7 (5·7)	112·0 (68·8)
Kamliakheri ..	Ap	0- 13	70·5	8·2 (0·2)	8·6 (3·3)	15·6 (4·0)	35·2 (2·9)	116·2 (89·6)
	C	45- 58	48·8	12·4 (10·6)	20·5 (20·3)	41·2 (10·1)	62·5 (3·5)	115·7 (55·5)

* C.E.C. by the sodium acetate method of Jackson[4]. † The values in parentheses indicate the per cent contribution of the size fraction to the C.E.C. of the soil.

To characterize the component responsible for the high C.E.C. values, the coarse silt and fine sand fractions of a profile of Kamliakheri series were subjected to specific gravity (S.G. 2·86; 2·86–2·62; 2·62–2·50; 2·50–2·35; $< 2 \cdot 35$) fractionation by bromoform-alcohol mixtures. Determination of the cation exchange capacities of these S.G. separates indicated that $< 2 \cdot 35$ S.G. separate has a C.E.C. of 80–90 me/100 g and contributes more than 60% to the C.E.C. of the whole fraction. The S.G. separate $< 2 \cdot 35$ is low in AP horizon and high in C-horizon.

Petrological examination of this S.G. separate showed that it is uniform and consists of individual particles. Grim[2] reported a specific gravity range of 2·2 to 2·7 for montmorillonites. Birrel and Gradwel[3] attributed the high C.E.C. of the size separate (S.G. 2·2 to 2·3) of some of the lateritic soils of volcanic origin to the presence of amorphous "Palagonite". X-ray analysis of the size separate ($< 2 \cdot 35$) in the present study confirmed the separate to be crystalline, dominant in montmorillonite. Full details will be published elsewhere.

Indian Agricultural Research Institute,
New Delhi-12,
November 5, 1969.
K. V. S. Satyanarayana.
R. P. Dhir.
G. S. R. Krishna Murti.
(Miss) Prem Jolly.

---

1. Satyanarayana, K. V. S., Sahi, B. P. and Krishna Murti, G. S. R., *Curr. Sci.*, 1969 (in press).
2. Grim, R. E., *Clay Mineralogy*, McGraw-Hill Book Co., Inc., New York, 1953, p. 313.
3. Birrel, K. S. and Gradwel, M., *J. Soil Sci.*, 1956, **7**, 130.
4. Jackson, M. L., *Soil Chemical Analysis*, Prentice Hall of India Private Ltd., New Delhi, 1967, p. 65.

NITRIFICATION/MINERALIZATION OF UREA AS AFFECTED BY NITRIFICATION RETARDERS 'N-SERVE' AND 'AM'

Since urea is planned to be the principal nitrogen fertilizer in India, its nitrification/mineralization as affected by nitrification retarders 'N-Serve' [2-chloro-6 (trichloromethyl) pyridine] and 'AM' (2-amino, 4-chloro, 6-methyl pyrimidine) was studied in a laboratory experiment. Ten grams of an air-dry sandy clay-loam soil was transferred to 50 ml. test-tubes.

Nitrogen as urea solution with or without 'N-Serve' or 'AM' and AM-fertilizer was applied at 100 ppm of soil. A no nitrogen control was included. 'N-Serve' was applied in acetone solution at 1 and 2 ppm and 'AM' at 5 and 10 ppm of soil. The test-tubes were covered with fine muslin cloth and incubated under laboratory conditions (Min. temp.: 20° ± 1° C, Max. temp.: 36° ± 5° C) for 40 days at field capacity moisture or under water-logged conditions. Samples were analysed in duplicate for ammonium, nitrite and nitrate N at 10 days' interval for those incubated at field capacity and at 20 days' interval for water-logged soils.

Nitrification rate (nitrates expressed as per cent of total mineral N) at field capacity moisture is presented in Fig. 1. Urea nitrified rapidly and after 20 days of incubation the nitrification rate was 94%. 'N-Serve' and 'AM' had a marked inhibitory effect on nitrification and even after 20 days the nitrification rate of urea treated with 'N-Serve' at 1 ppm and 'AM'. at 5 ppm was only 72% and 74%, respectively. Increase in concentration of 'N-Serve' and 'AM' further retarded nitrification of urea. Nitrification retarders were effective even at the end of the 40 days' period to which the present studies were restricted. After 40 days of incubation, the nitrification rate of urea treated with 'N-Serve' at 2 ppm and 'AM' at 10 ppm was 78% and 76% respectively, as against 100% in case of urea. Lowest nitrification rate was recorded with AM-fertilizer and after 40 days the nitrification rate was only 71%.

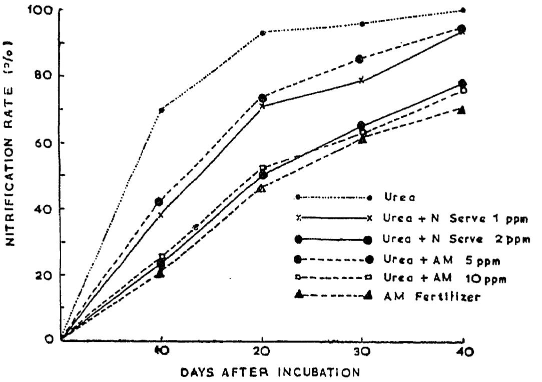


FIG. 1. Nitrification of urea as affected by nitrification retarders. (Nitrogen applied 100 ppm.).

Since under water-logged conditions nitrates and nitrites are unstable, only ammonium N could be estimated in the samples incubated under these conditions. It is interesting to note (Table I) that ammonium N was higher when urea was treated with 'N-Serve' or 'AM' or when AM-fertilizer was used. Possibly some of the ammonium N produced on mineralization of urea was oxidized to nitrates and lost by denitrification and that this loss of N was prevented by nitrification retarders. There was no difference between two nitrification retarders and AM-fertilizer.

TABLE I

Effect of nitrification retarders on mineralization of urea under water-logged conditions

Treatment		Period of incubation	
		20 days	40 days
		Ammonium N—ppm of oven-dry soil	
Control (no nitrogen)	..	12	13
Urea	.	79	84
Urea+'N-Serve' at 1 ppm	..	85	91
Urea+'N-Serve' at 2 ppm	..	86	96
Urea+'AM' at 5 ppm	..	86	93
Urea+'AM' at 10 ppm	..	87	94
AM-fertilizer	..	96	94

Agronomy Division, I.A.R.I., New Delhi-12,
December 19, 1969.

G. B. RAJALE.
RAJENDRA PRASAD.

LACTIC DEHYDROGENASE ISOZYME IN AVIAN LEUKOSIS (MYELOBLASTOSIS)

THE elevation of Lactic Dehydrogenase (LDH) activity has been reported by several workers with certain neoplastic diseases.[1,2] Wallbank *et al.*[3] have reported that LDH activity in the plasma of birds injected with leukosis viruses is increased considerably. It was of interest to see if this increased activity entails with it any change in the isozyme distribution pattern which can be related to the virus infection. In this study it is found that only one isozyme is predominant in the leukemic bird plasma. This predominant isozyme is however identical to that of the virus associated circulatory leukemic myeloblasts in the blood.

Blood plasma was obtained from normal white Leghorn chickens of line 15[4] and from the same birds with myeloblastic leukemia induced by intravenous inoculation with the BAI strain A (myeloblastosis) virus. Myeloblasts were obtained from circulatory blood of leukemic birds. Cells collected by centrifugation were washed twice[5] and stored at − 20° C until needed. 3 μl serum from both normal and infected birds was incorporated in the sample gel. Disc electrophoresis was carried out according to Davis[6] using 7% acrylamide and a running pH of 9·5. The current was 5 m Amp for each column and duration of the run was 30 minutes. LDH bands were visible in the gel after incubation in dark for 30 minutes in the reagent solution.[7] The same were photographed. Myeloblasts washed and stored were homogenised and the homogenate was spun at 105,000 × g in a Spinco preparative centrifuge to get a soluble fraction. Soluble fraction containing an identical activity of LDH as in leukemic plasma was applied to the sample gel.

The LDH isozyme pattern of the normal bird plasma, leukemic bird plasma and that of the virus associated myeloblast-soluble fraction can be seen in Fig. 1. There is only one band in both leukemic plasma and myeloblast-soluble fraction which are identical in their electrophoretic mobility. Of the two bands present in normal bird plasma, the slow migrating one which corresponds to LDH-5 is identical electrophoretically to the band present in both leukemic plasma and myeloblast-soluble fraction. This indicates that in the leukemic chickens, the LDH-5 is produced in excess and released to the blood stream. Since the birds were normal except the viral infection, the only source of this altered isozyme production seems to be the myeloblast cell in the circulation which are produced in a larger number after viral infection constituting half or more of the total blood volume. Further, the presence of only muscle type isozyme (LDH-5) in the leukemic myeloblasts indicates that there is a high rate of glycolysis in these cells not unlike several other neoplastic cells.

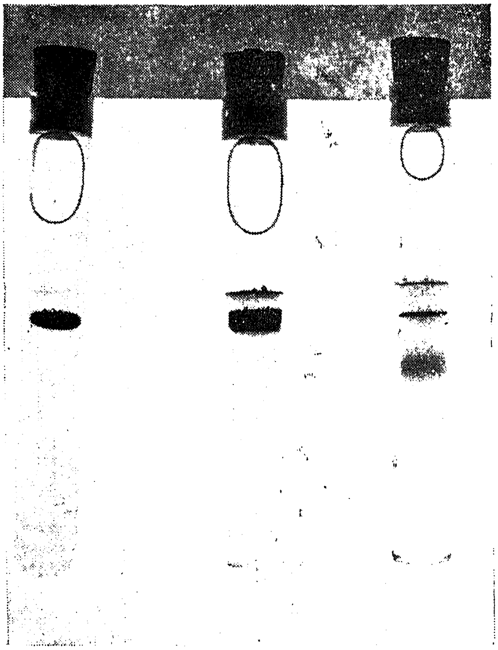


FIG. 1. LDH isozyme patterns of normal chicken plasma (right-hand gel), leukemic chicken plasma (center gel) and the virus associated myeloblast cell soluble fraction (left gel). Electrophoresis and incubation in the reagent for the three gels was carried out in identical conditions.

Dept. of Zoology, P. R. Rao.*
Osmania University,
Hyderabad-7, India, *November* 25, 1969.

---

* This work was done while the author was at Duke University Medical Center, U.S.A.

1. Msieh, K. M. and Blumenthol, H. T., *Proc. Exptl. Biol. Med.*, 1956, **91**, 626.
2. Hill, B. R. and Levi, C., *Cancer Res.*, 1954, **14**, 513.
3. Wallbank, A. M., Sahl, J., Hubben, K., Mollister, C. J., Sperling, F. G. and Stubbs, E. L., *Nature*, 1964, **201**, 844.
4. Eckert, E. A., Waters, N. F., Burmester, B. R., Beard, D. and Beard, J. W., *J. Natl. Cancer Inst.*, 1954, **14**, 1067.
5. Beaudreau, G. S., Becker, C., Sharp, D. G., Painter, J. C. and Beard, J. W., *Ibid.*, 1958, **20**, 351.
6. Davis, B. J., *Ann. N.Y. Acad. Sci.*, 1964, **121**, 404.
7. Vesell, E. S., *Ibid.*, 1961, **94**, 877.

UNUSUAL FINDING OF CARTILAGE IN EYELID

THE reflex mechanism of the eyelids is a very important function in protecting the eye against injury. It is well known that the eyelids are built up of sebaceous glands, muscle fibres, tarsal plate and conjunctiva. The presence of cartilage in the eyelid does not seem to have been recorded in the literature.

To study the distribution of goblet cells in conjunctiva in an experiment in albino rats, the eye-ball with eyelids was removed. Paraffin sections prepared from the tissues were stained for mucopolysaccharides in the goblet cells of conjunctiva. A piece of cartilage was accidentally found attached with tarsal plate in the eyelid. It was difficult to make out where exactly the cartilage was situated and whether it was in the upper, or lower, eyelid. Consequently, sixty eyelids, both upper and lower, were collected separately and processed for paraffin section. Before embedding in paraffin, the eyelids were divided longitudinally, taking care to make sure of the position to which they belonged.

In all the upper eyelids, a small group of rounded cells in an interstitial matrix was found just above the tarsal plate. Even though the matrix contained collagenous fibres, it appeared homogeneous. The interstitial substance was markedly basophilic and reacted to P.A.S. staining, indicating the presence of condromucoid substance and thereby establishing its identity as a piece of cartilage (Fig. 1). The cartilage was found almost in the centre of the upper eyelid just above the tarsal plate. The lower eyelid did not reveal the presence of cartilage.

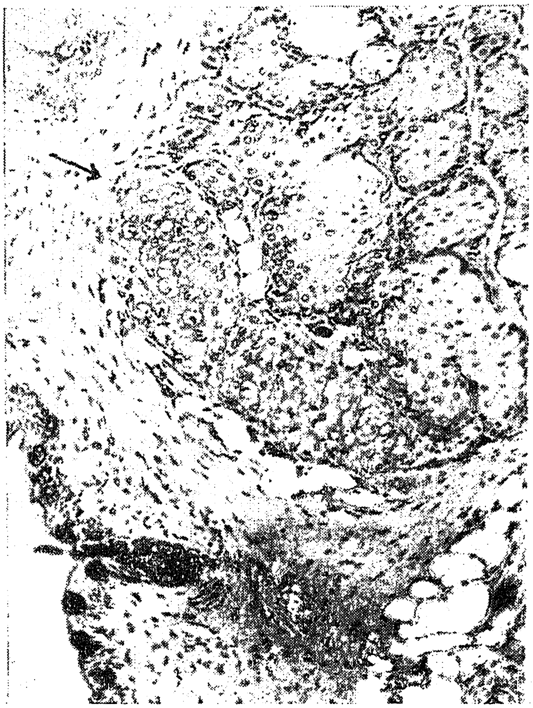


FIG. 1. Section of eyelid showing cartilage. P.A.S. and Hematoxylin, × 100.

In order to establish whether the occurrence of cartilage in eyelids is a feature common to mammals in general, the eyelids of rabbits, guinea-pigs, black rats and mice were examined. While the eyelids of rabbits and guinea-pigs did not reveal the presence of cartilage, a well-developed cartilage was seen in the upper eyelids of black rats and mice.

It is possible that the development of mesenchymal condensation into cartilage is induced by local requirement, as a special measure for the protection against mechanical injury of the eye in rats. At the moment it is difficult to say whether cartilage is present in other species of animals also.

Central Food Tech. Res. Institute,
Mysore-2 A, *November* 30, 1969.
A. PAUL JAYARAJ.

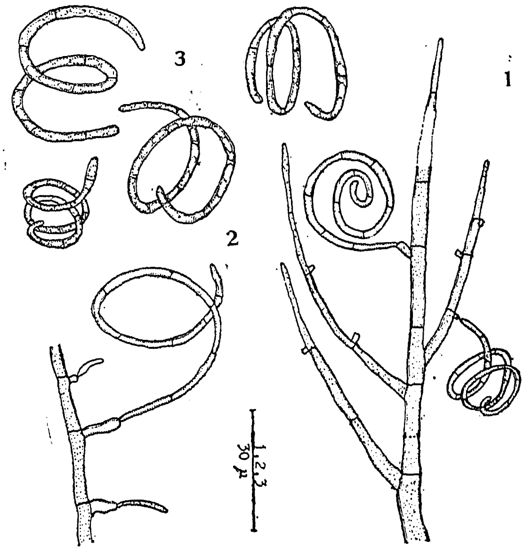
A NEW HELICOSPOROUS HYPHOMYCETE FROM INDIA

THE various Helicosporæ of Hyderabad were described by Raghuveer Rao and Dev Rao (1964 *a*, 1964 *b*) in which under *Helicosporium* Nees four species, *viz.*, *H. guianensis* Linder, *H. Neesii* Moore, *H. indicum* Rao and Rao and *H. nizamabadense* Rao and Rao were reported. In this communication a new *Helicosporium* is described.

Helicosporium hiospiroides SP. NOV

Colonies irregular superficial, deep yellow and later become brown on drying, floccose, amphigenous. Mycelium superficial, septate, smooth, branched, thin-walled, 3·6–5·4 μ broad. Conidiophores originate singly or in groups, well developed, erect, ascending, rarely simple usually branched, light fuscous and thick-walled at base getting thin-walled and hyaline in the anterior region, septate, smooth. The branches of the conidiophores are produced just below the septum of the main axis or otherwise; they may be sterile or fertile, stipe 159–256 μ long, 5·6–8·6 μ broad at base and up to 1·4 μ in the upper region, branches 122–150 μ long. The long drawn out apices of conidiophores and its branches also become somewhat loosely coiled looking like conidia. The helicospores are produced on the bladder like projections borne on the main axis or its branches, the projections are 1-celled, smooth, thin and hyaline, 4·2–16·8 μ long, 1·4–4·2 μ wide. Helicospores are hyaline, hygroscopic, smooth, contents refractive, 21–35 μ diameter, filaments 1·4–2·8 μ thick, septate, 1–4 times spirally coiled in one or peculiarly in two planes forming a loose spiral, *i.e.*, open at both the ends, despite yellow colonies conidial mass does not look so. This fungus is a *Helicosporium* and is nearer to *H. aureum* (Corda) Linder, in having branched conidiophores and also close to *H. citreoviride* Tubaki (1964), which has unbranched conidiophores. Almost all species of *Helicosporium* produce conidia coiled in one plane but the conidia in our taxon are loosely coiled in two planes a manner quite similar to that of *Helicoon* Morgan, *Helicodendron* Peyron., and *Hiospira hendreckxii* (Hansford) Moore (1955, 1962), (= *Helicosporium hendreckxii*). In the former two taxa they are ellipsoidal to doliform while the spore profile in the latter is consistently cylindrical, *i.e.*, the basal and distal ends of the filament do not approach or cross the long axis and remain open at both the ends. As far as we are aware of there is no species of *Helicosporium* known with these characters, therefore, described new as *H. hiospiroides*, the specific epithet is suggestive of the conidial coiling of *Hiospira*.

Collected on old unidentified woods from Adilabad forest on 21–2–1969, Coll. SR., V.V.C.B.L. No. 835.



FIGS. 1–3. *Helicosporium hiospiroides* (from type material V.V.C.B.L. No. 835). Figs. 1 & 2. Conidiophores with helicospores. Fig. 3. Helicospores.

Helicosporium hiosphroides SP. NOV.

Coloniæ effusæ, irregularia, superficialia, floccosæ, amphigenæ. Mycelium superficialia, ramosa, septata, subhyalina vel hyalina, 3·6–5·4 μ crassis. Conidiophora erecta e hyphis septatæ, ramosæ vel simplices, fusca vel subhyalina ad basin pallidiora vel hyalina ad apicem, 5·6–8·6 μ crassis ad basin, 1·4 ad apicem, 150–256 μ longa, ramuli conidiophora 122–150 μ longa. Conidia septatæ, laxæ convoltae vicibus 1–4 in di vel mono planis, diametro 21–35 μ, fila 1·4–2·8 μ crassæ.

Thanks are due to Dr. Royall T. Moore, Electron Microscope Laboratory, California, Berkeley, U.S.A., for literature, to Prof. M. R. Suxena, Department of Botany, Osmania University, Mr. P. S. Rao, Principal, Dr. S. D. Satwaleker, former Principal, Vivek Vardhin College and Mr. B. Bhoom Rajam, D.F.O., Nirmal, for facilities and encouragement.

Dept. of Botany, B. SHIVALING REDDY.
Vivek Vardhini College DEV RAO.
and Saifabad Science VASANT RAO,
College,
Hyderabad-A.P., *April* 5, 1969.

1. Moore, R. T., *Mycologia*, 1955, **47**, 90.
2. —, *Trans. Brit. Mycol. Soc.*, 1962, **45** (1), 143.
3. Raghuveer Rao and Dev Rao, *Mycopathol. Mycol. Appl.*, 1964 *a*, **22** (1), 47.
4. — and —, *Ibid.*, 1964 *b*, **24** (1), 27.
5. Tubaki, K., *Trans. Mycol. Soc. Japan*, 1964, **5** (1), 2.

A NOTE ON AN ABNORMAL *COSMARIUM*

THIS note records an abnormal desmid observed by the authors in the course of investigations on the desmids of U.P. (India). The alga was collected from Telibagh about seven miles from Lucknow. It was found growing in a pond along with *Oedogonium* sp., *Spirogyra* sp. and other desmids and diatoms.

Unlike normal desmids having only two semicells, the vegetative body of this desmid consists of five semicells. The two semicells at the two ends have a wavy outline while the remaining three intercalary semicells possess a more or less smooth outline (Fig. 1, *a*). Each semicell has an ill-defined chloroplast laden with starch and contains a single pyrenoid.

The entire body of the desmid measures 67·4 μ in length; the terminal semicells are 22·5 μ broad while the median three semicells are 28 μ across. The two distal isthmuses measure 7 μ each while the middle ones are 8·5 μ across.

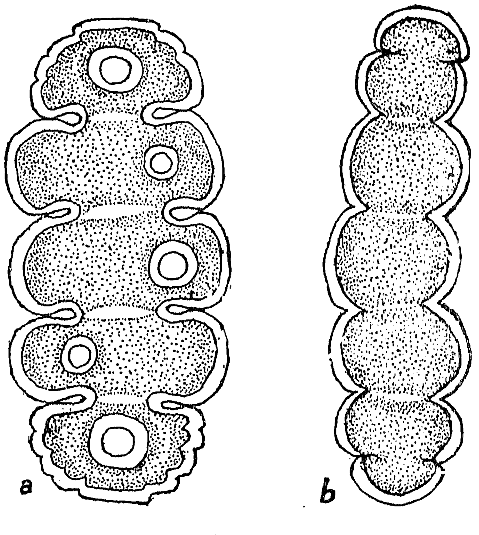


FIG. 1 *a–b*. Abnormal *Cosmarium* sp., × 1,000. (*a*) Front view showing the two distal semicells with wavy outlines and the three median semicells with smooth outlines. (*b*) Side view of the same.

But for the number of semicells constituting the body, the alga resembles a *Cosma-*

rium.[1,2] The abnormality has apparently occurred due to abnormal behaviour during cell division, resulting in the formation of three new semicells and their subsequent failure to separate so that three extra semicells have become intercalated, thus giving rise to five connected semicells (Fig. 1, *a*, *b*).

Dept. of Botany, Braj Nandan Prasad.
Lucknow University, R. K. Mehrotra.
Lucknow, *November* 21, 1969.

---

1. Fritsch, F. E., *The Structure and Reproduction of the Algae*, Cambridge, 1935, Vol. I.
2. West, W. and West, G. S., *Monograph of the British Desmidiaceæ*, 1904, Vols. 1-4.

A BACTERIOPHAGE AGAINST *XANTHOMONAS MALVACEARUM* (E. F. SMITH) DOWSON, THE INCITANT OF BLACK ARM OF COTTON

A phage against *Xanthomonas malvacearum* has been isolated from severely infected cotton leaves collected from the fields of this Institute by the following procedure. Five grams of severely infected leaves (dry) were chopped and suspended in 50 ml of nutrient broth solution for 48 hr at 25-28° C. The suspension was filtered through sintered glass bacterial filter. One ml of this filtrate or its serial dilution was mixed with one ml of bacterial suspension made from 48 hr old slant culture and 25 to 30 ml melted nutrient agar and poured in petri dishes to obtain well-isolated plaques. The plaques usually appeared in the plates within 24 hr at 25-28° C (Fig. 1). Single plaques were picked up in sterile distilled water columns and stored in a refrigerator.

The activity of the phage was tested against various other phytopathogenic xanthomonads, *viz*., *X. alfalfæ*, *X. campestris*, *X. cassiæ*, *X. patelii*, *C. punicæ*, *X. ricinicola*, *X. rubrilineans* and *X. uppalii* and none of them was found to be susceptible, indicating thereby that the phage is host-specific.

The phage was used for grouping different isolates of *X. malvacearum* into different lysotypes (phage differentiated strains) by employing the spot test technique. One loopful of the phage was placed in plates previously poured with nutrient agar medium mixed with the test isolate and the plates were incubated at 25-28° C. If an isolate was susceptible to the phage, lysis in the form of clear zone occurred at the site of inoculation within 24 hr. It was found that 20 out of 23 isolates, which were collected from North India, were susceptible to the phage while the remaining three were resistant. There is some indication that only the resistant isolates could utilize lactose with the production of acid. Similar results were reported by Hayward.[1] But in principle there was no relation in the races differentiated by phage typing, biochemical or pathogenic reactions, which are the other methods to characterise races of *X. malvacearum*.[2-5] However, it can be concluded from the present investigations that the bacterial isolates could be differentiated into two lysotypes based on their reaction to one phage.

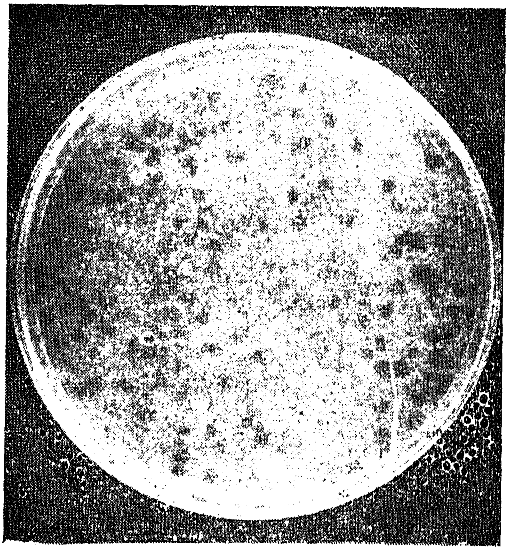


FIG. 1. Bacteriophage plaques on *Xanthomonas malvacearum*.

The authors are grateful to Dr. S. P. Raychaudhuri for his keen interest.

Division of Mycology and Plant Pathology, R. P. Singh.
I.A.R.I., New Delhi, Y. P. Rao.
November 18, 1969. J. P. Verma.

---

1. Hayward, A. C., *J. gen. microbiol.*, 1964, **35**, 287.
2. Massey, R. E., *Empire Cott. Gr. Rev.*, 1931, **8**, 187.
3. Nayudu, M. V., *Ind. Cott. Gr. Rev.*, **18**, 350.
4. Hunter, R. E., Brinkerhoff, L. A. and Bird, L. S., *Phytopathology*, 1968, **58**, 83.
5. Verma, J. P. and Singh, R. P., *Curr. Sci.*, 1970, **39**, 20.

REVIEWS AND NOTICES OF BOOKS

Superconductivity (Vols. 1 and 2). Edited by R. D. Parks. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969.
Volume 1: Pp. xv + 664; Price $45.00; £ 21-8 *sh.*-0 *d.*
Volume 2: Pp. xv + 748; Price $45.00; £ 21-8 *sh.*-0 *d.*
Volumes 1 and 2: Price $ 75.00; £ 35-13 *sh.*-0 *d.*

This two-volume treatise is the first recent work to review in a truly comprehensive manner all phases of superconductivity.

Thirty-three internationally known authors have contributed 23 chapters, carefully organized to present the material in a meaningful sequence and to place each contribution in proper perspective. For instance, a thorough exposition of the BCS theory provides the setting for the chapters that follow: mathematical techniques used extensively throughout the treatise are developed in the early chapters. Over 450 illustrations and photographs, numerous tables, and an extensive subject index enhance the usefulness of the treatise.

The titles of the chapters contained in Volume 1 are listed below: 1. Early Experiments and Phenomenological Theories, by B. S. Chandrasekhar; 2. The Theory of Bardeen, Cooper, and Schrieffer, by G. Rickayzen; 3. Equilibrium Properties: Comparison of Experimental Results with Predictions of the BCS Theory, by R. Meservey and B. B. Schwartz; 4. Non-equilibrium Properties: Comparison and Experimental Results with Predictions of the BCS Theory, by D. M. Ginsberg and L. C. Bebel; 5. The Green's Function Method, by Vinay Ambegaokar; 6. The Ginzburg-Landau Equations and Their Extensions; 7. Collective Modes in Superconductors, by Paul C. Martin; 8. Macroscopic Quantum Phenomena, by James E. Mercereau; 9. Weakly Coupled Superconductors, by B. D. Josephson; 10. The Electron-Phonon Interaction and Strong-Coupling Superconductors, by Douglas J. Scalapino; 11. Tunneling and Strong-Coupling Superconductivity, by W. L. McMillan and J. M. Rowell; and 12. Superconductivity in Low-Carrier-Density Systems: Degenerate Semiconductors, by Marvin L. Cohen.

The titles of the chapters contained in Volume 2 are listed below: 13. Superconductivity in the Transition Metals: Theory and Experiment, by G. Gladstone, M. A. Jensen and J. R. Schrieffer; 14. Theory of Type II Superconductors, by Alexander L. Fetter and Pierre C. Hohenberg; 15. Type II Superconductors: Experiments, by Bernard Serin; 16. Boundary Effects and Small Specimens, by J. P. Burger and D. Saint James; 17. Proximity Effects, by G. Deutscher and P. G. de Gennes; 18. Gapless Superconductivity, by Kazumi Maki; 19. Flux Flow and Irreversible Effects, by Y. B. Kim and M. J. Stephen; 20. A Comparison of the Properties of Superconductors and Superfluid Helium, by W. F. Vinen; 21. The Intermediate State in Type I Superconductors, by J. D. Livingston and W. DeSorbo; 22. Superconducting Devices, by V. L. Newhouse; and 23. Superconductivity in the Past and the Future, by P. W. Anderson.

An indispensible work for theoretical and experimental physicists, low temperature experimenters, graduate students, and others interested in superconductivity, this treatise is complete and authoritative in its field.

C. V. R.

Advances in Chromatography (Vol. 8). Edited by J. C. Giddings and R. A. Keller. (Marcel Dekker, Inc., 95, Madison Avenue, New York, U.S.A.), 1969. Pp: xvi + 400: Price $ 18.75.-£ 8-18 *sh.*

The explosive growth of chromatography has made it difficult for any single individual to maintain a coherent view of the field's progress. It is clear that the individual research worker, if he is to preserve even a moderate knowledge of advances in the area, must rely upon responsible surveys, rather than attempt to read the avalanche of original research papers in the field. In this volume of *Advances in Chromatography*, as in all volumes of this services, critical, current surveys of the most important advances in the respective areas of chromatography, written by noted authorities in chromatographic science, are presented.

The subject-matter in this volume has been dealt with in two sections, *viz.*, General Chromatography and Gas Chromatography.

The main titles of the articles under General Chromatography are: Principles of Gel Chromatography, by Helmut Determann; Thermodynamics of Liquid-Liquid Partition

Chromatography, by David C. Locke; Determination of Optimum Solvent Systems for Countercurrent Distribution and Column Partition Chromatography from Paper Chromatographic Data, by Edward Soczewinski; and Some Procedures for the Chromatography of the Fat-Soluble Chloroplast Pigments, by Harold H. Strain and Walter A. Svec.

The main titles of the articles under Gas Chromatography are: Comparison of the Performances of the Various Column Types Used in Gas Chromatography, by Georges Guiochon; Pressure (Flow) Programming in Gas Chromatography, by Leslie S. Ettre, Laszlo Mazor and Jozsef Takacs; Gas Chromatographic Analysis of Vehicular Exhaust Emissions, by Basil Dimitriades, C. F. Ellis, and D. E. Seizinger; and The Study of Reaction Kinetics by the Distortion of Chromatographic Elution Peaks, by Maarten van Swaay. C. V. R.

Annual Review of Microbiology (Vol. 23). Edited by C. E. Clifton. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1969. Pp. vii + 622. Price $ 8.50 in U.S.A. and $ 9.00 elsewhere. (Shipments after January 1, 1970, subject to price increase, *viz.*, $ 1.50. per copy.)

Volume 23 of this well-known series contains the following articles: Prefatory Chapter: Sequences in Medical Microbiology. Some Observations over Fifty Years, by Stuart Mudd; Structure, Physiology, and Biochemistry of the Chrysophyceæ, by Mary Belle Allen; Regulation of Enzyme Function, by Daniel E. Atkinson; Bacterial Conjugation, by Roy Curtiss, III: Rhizobia (With Particular Reference to Relationships with Host Plants), by R. O. D. Dixon; The Topography of the Bacterial Cell-Wall, by Audrey M. Glauert and Margaret J. Thornley; Induction of Antibodies *In Vitro*, by Marvin Fishman; Sequence of Bacterial Reproduction, by Charles E. Helmstetter; New Approaches to Bacterial Taxonomy: Perspective and Prospects, by M. Mandel; Rickettsiæ (As Organisms), by Richard A. Ormsbee; Defective DNA Animal Viruses, by Fred Rapp; Structure and Function in Mycoplasma, by Shmuel Razin; *Bacillus thuringiensis*: Microbiological Considerations, by Martin H. Rogoff and Allan A. Yousten; *Escherichia coli* Ribosomes: Recent Developments, by David Schlessinger and David Apirion; Chemotherapy of the Drug-Resistant Malarias, by L. H. Schmidt; Paleomicrobiology, by F. M. Swain; Kinetics of Nutrient-Limited Growth, by N. van Uden; Ultraviolet-Induced Mutation and DNA Repair, by Evelyn M. Witkin; Total Synthesis of Acetate from CO_2 by Heterotrophic Bacteria, by Lars G. Ljungdahl and Harland G. Wood; Carbohydrate Metabolism in Micro-organisms, by R. L. Anderson and W. A. Wood; and Other Reviews of Microbiological Interest.

C. V. R.

Basic Biochemical Calculations (*Related Procedures and Principles*). By J. S. Finlayson. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W. 1, England), Pp. 329. Price 43 *sh.*

The book is intended for self-study and covers a number of essential practical areas which are often scantily handled or only theoretically treated in formal courses. Important topics include units of measurement, pH of solutions, buffers, spectrophotometry and other optical methods of biochemistry, yields and recoveries, enzyme assays, separation techniques, and isotopic tracer techniques. The book is so organized that individual chapters may be referred to out of sequence.

A. S. G.

Introduction to the Theory of Arithmetic. By Charles F. Brumfiel and Eugene F. Krause. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W. 1, England), Pp. 347. Price 54 *sh.*

The purpose of the book is to provide a coherent modern analysis of elementary mathematics. It is intended primarily for prospective elementary teachers, but the point of view adopted makes it suitable for a "cultural mathematics" course at the junior college level. It helps to understand old arithmetic by the new way, emphasizing the development of abstract conceptions. A. S. G.

Books Received

Programming for a Digital Computer in the Fortran Language. By H. S. Wilf. (Addison-Wesley Publishing Co., Reading, Mass.), 1969. Pp. vii + 86. Price 26 *sh.*

The Real Computer—Its Influence, Uses, and Effects. By F. G. Withington. (Addison-Wesley Publishing Co., Reading, Mass.), 1969. Pp. ix + 350. Price 82 *sh.*

1951-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

RADIOCARBON DATES OF SOME QUATERNARY SAMPLES

D. P. AGRAWAL, S. K. GUPTA AND SHEELA KUSUMGAR
Tata Institute of Fundamental Research, Bombay-5

ABSTRACT

The C^{14} dates presented here date various eustatic levels of the late Quaternary period in India. Some of the complete regional pollen sequences too have been dated for the first time.

THE problems of the Quaternary period in India are being tackled by various institutions from various angles. These attempts will eventually lead to a palæo-climatological and ecological reconstruction of the Quaternary period, as also to the dating of various Stone Age industries and the eustatic changes.

Presented below are the C^{14} dates of some such Quaternary samples. The dates given are in years B.P. based on 5568 ± 30 yrs. half-life value; those given in parenthesis are on the basis 5730 ± 40 yrs. For modern reference standard, N.B.S. oxalic acid is used. For converting the dates to A.D./B.C. scale, 1950 has been used as the base year. The techniques used have been described elsewhere (Agrawal *et al.*, 1965).

ACKNOWLEDGEMENTS

The authors are thankful to Prof. D. Lal for guidance, and to Shri S. V. Kerkar for assistance.

C^{14} DATES WITH SAMPLE DESCRIPTIONS

Continental Shelf, West Coast, India

These samples were collected by dredging on the continental shelf by R. R. Nair, National Institute of Oceanography, Panaji, Goa.

TF-983, Late Quaternary, 8880 ± 125
(9135 ± 130)

Shells from the continental shelf off Karwar (Lat. 10° 33′ N., Long. 73° 43′ E.). Water depth 58·5 m., Sample No. 653.

TF-969, Late Quaternary, 140 ± 90
(145 ± 95)

Coral from the continental shelf off Bombay (Lat. 18° 36′ N., Long. 70° 39′ E.). Pure Aragonite. Water depth 96 m., Sample No. 42 b.

General comment: The ages seem to be lower than expected.

Coondapoor, Mysore, India

TF-814, Quaternary, > 40000
(> 45000)

Submerged mangrove (?) plants from Coondapoor (Lat. 13° 45′ N., Long. 74° 45′ E.). District South Kanara, Depth 6·12 to 9·2 m, Sample was submitted by Shri K. S. Karanth, Puttur, S. Kanara.

Kakathope Madras, India

Kakathope (Lat. 11° 35′ N., Long. 76° 52′ E.), District Nilgiris. Samples collected by H. P. Gupta, Birbal Sahni Institute of Palæobotany, Lucknow. NaOH pretreatment was given to both the samples.

TF-695, Late Quaternary, 14980^{+355}_{-340}

$\left(15415^{+365}_{-350}\right)$

Organic mud, Depth. 2·0–2·3 m., Field No. 4789/3. Sample No. 1.

TF-696, Late Quaternary, 23590^{+740}_{-675}

$\left(24275^{+760}_{-695}\right)$

Organic mud, Depth 3·2 to 3·5 m., Field No. 4789/3, Sample No. 2.

General comment: The material was recovered by borings to date the pollen zones.

Little Rann of Kutch Gujarat, India

TF-807(a), Late Quaternary, 13640 ± 200
(14035 ± 205)

Shells from the bore-hole No. 6 at Surajbari (Lat. 23° 8′ N., Long. 70° 42′ E.), District Kutch. The bore-hole was drilled for the construction of railway bridge. Depth 19 m. below M.S.L. Sample is from the top of a bed which is 0·83 m. thick. Field No. 7. Submitted by Y. G .K. Murty, Geological Survey of India, Ahmedabad.

TF-807(b), Late Quaternary, 15995 ± 250
(16460 ± 225)

Shells from the bore-hole No. 6 at Surajbari, Depth. 19·85 m. below M.S.L. bottom of the bed; Field No. 7. Submitted by Y. G. K. Murty.

TF-808, Holocene, 575 ± 105
(590 ± 110)

Shells from the creek cutting between the bore-holes 9 and 10 at Surajbari. Shells from depths 1·0 m, and 1·3 m, were mixed. Field

Nos. 10 A and 10 B. Submitted by Y. G. K. Murty.

TF-913, Holocene, 6315 ± 95
(6500 ± 95)

Shells from the walls of a brine well in the Little Rann of Kutch off Kuda (Lat. 23° 13′ N., Long. 71° 23′ E.), District Kutch, Depth. 5·7 m., Location No. 17, Sample No. 1. Submitted by S. K. Gupta, T.I.F.R., Bombay 5.

TF-914, Holocene, 5925 ± 105
(6100 ± 110)

Shells from the walls of a brine well in the Little Rann of Kutch off Kuda, Depth between 7·9 and 8·2 m., Location No. 16, Sample No. 1. Submitted by S. K. Gupta.

TF-915, Holocene, 6640 ± 125
(6835 ± 130)

Shells from the walls of a brine well in the Little Rann of Kutch off Jhinjunvada (Lat. 23° 24′ N., Long. 71° 32′ E.), District Kutch, Depth between 5·1 and 5·5 m., Location No. 13, Sample No. 1. Submitted by S. K. Gupta.

TF-917, Holocene, 6835 ± 110
(7035 ± 110)

Wood from the walls of a brine well in the Little Rann of Kutch off Kharagodha (Lat. 23° Little Rann of Kutch off Kharagodha, Depth between 5·4 and 7·1 m., Location No. 2, Sample No. 1 *c*. NaOH pretreatment was given. Submitted by S. K. Gupta.

TF-919, Holocene, 5900 ± 105
(6075 ± 110)

Shells from the walls of a brine well in the Little Rann of Kutch off Kharagodha, Depth. between 2·6 and 2·9 m., Location No. 2, Sample No. 1(*a*). Submitted by S. K. Gupta.

TF-920, Holocene, 6860 ± 110
(7060 ± 115)

Wood from the walls of a brine well in the Little Rann of Kutch off Kharagodha, Depth between 2·4 and 3·5 m., Location No. 1, Sample No. 1. Submitted by S. K. Gupta.

TF-927, Holocene, 4685 ± 100
(4820 ±105)

Shells from the bore-hole No. RH 27(*d*) in the Little Rann of Kutch at Surajbari (Lat. 23° 08′ N., Long. 70° 42′ E.). District Kutch, Depth 7 m., Sample No. 3, Field No. RH 27 (*d*)/3. Submitted by S. K. Gupta.

TF-930, Holocene, 3720 ± 100
(3830 ± 105)

Shells from the bore-hole No. RH 27(*c*) in the Little Rann of Kutch at Surajbari, Depth 4·9 m., Sample No. 3, Field No. RH 27(*c*)/3. Submitted by S. K. Gupta.

TF-932, Holocene, 6600 ± 105
(6795 ± 110)

Shells from the bore-hole No. RH 24 in the Little Rann of Kutch at Surajbari, Depth 16 m., Sample No. 7, Field No. RH 24/7. Submitted by S. K. Gupta.

General comment: The average height of the plain of the Little Rann of Kutch is 2·4 m. above M.S.L.

Paithan, Maharashtra, India

TF-891, Late Quaternary, 18490 ± 650
(19025 ± 660)

Freshwater shells from Paithan (Lat. 19° 31′ N., Long. 75° 22′ E.), District Aurangabad. The sample derives from a gravel bed of an old flood plain of river Godavari, Depth 5 m. Submitted by A. Parthasarathy, Indian Institute of Technology, Powai, Bombay.

Sambhar Lake, Rajasthan, India

Sambhar salt lake (Lat. 26° 54′ N., Long. 75° 13′ E.), District Jaipur. The samples were collected and submitted by Gurdip Singh, Birbal Sahni Institute of Palæobotany, Lucknow, for dating the pollen zones. NaOH pretreatment was given to all the samples.

TF-698, Late Quaternary, 8585 ± 140
(8835 ± 140)

Organic debris, Depth 3·27 to 3·35 m., Field No. S-2/327–335, Sample No. RC-2.

TF-738, Late Quaternary, 8065 ± 135
(8300 ± 135)

Organic debris, Depth 2·70 to 2·85 m., Field No. S-2/270–285, Sample No. RC-3.

TF-739, Late Quaternary, 4535 ± 110
(4665 ± 115)

Organic debris, Depth. 1·50 to 1·60 m., Field No. S-2/150–160, Sample No. RC-4.

TF-883, Late Quaternary, 4385 ± 110
(4510 ± 110)

Organic debris, Depth 1·35 to 1·50 m., Field No. S-2/135–150. Sample No. RC-6.

TF-884, Late Quaternary, 6060 ± 310
(6235 ± 315)

Organic debris, Depth 1·85 to 1·95 m., Field No. S-2/185–195. Sample No. RC-7.

Comment: Errors are large as Anthracite was mixed because of the inadequacy of the sample weight.

TF-887, Late Quaternary, 8990 ± 125
(9250 ± 130)

Organic debris, Depth 3·15 to 3·25 m., Field No. S-2/315–325, Sample No. RC-10, *General comment*: Samples were obtained from a profile exposed by digging a pit in the bed of the salt lake. The samples in the form of 6″ cubes of sediment were carved out at regular intervals. The samples were composed of organic debris, mainly in the form of tiny carbonised wood fragments, and were isolated from the bulk samples of silty clay by means of differential sedimentation and treatment with HCl and HF.

Sankrail, West Bengal, India

Sankrail (Lat. 22° 35′ N., Long. 88° 20′ E.), District Howrah. Samples collected and submitted by Vishnu Mittre and H. P. Gupta.

TF-850, Late Quaternary, 2540 ± 100
(2615 ± 100)

Peaty clay, Depth 1·4 m., Sample No. 1.

TF-851, Late Quaternary, 3960 ± 95
(4075 ± 100)

Peat, Depth 1·8 m., Sample No. 2.

TF-853, Late Quaternary, 4785 ± 105
(4925 ± 110)

Wood, Depth 1·5 m., Sample No. 4, NaOH pretreatment was given.

TF-855, Late Quaternary, 4590 ± 130
(4720 ± 135)

Peat, Depth 3 m., Sample No. 6.

TF-856, Late Quaternary, 5645 ± 105
(5810 ± 110)

Peat, Depth 6 m., Sample No. 7.

TF-857, Late Quaternary, 5285 ± 110
(5440 ± 115)

Wood, Depth not given, Sample No. 8.

General comment: Samples were collected from an already exposed and uncovered trench which was frequently flooded by Hoogli river.

Saurashtra Coast, Gujarat, India

TF-902, Late Quaternary, $35050\,^{+5390}_{-3200}$

$$\left(36070\,^{+5550}_{-3290}\right)$$

Shells from a raised beach near Porbander Villa (Lat. 28° 38′ N., Long. 69° 36′ N.), District Junagadh. Location No. 33, 3·5 m., height above High Water Level (H.W.L.), Sample No. 1. Submitted by S. K. Gupta.

TF-903, Late Quaternary, $27710\,^{+1400}_{-1190}$

$$\left(28515\,^{+1440}_{-1225}\right)$$

Coral from an emerged reef at Visawara village (Lat. 21° 45′ N., Long. 69° 26′ E.), District Junagadh. Location No. 34, 4·3 m., height above H.W.L., Sample No. 1. Submitted by S. K. Gupta.

TF-905(A), Late Quaternary, 14565 ± 185
(14990 ± 190)

Pieces of corals from a raised reef deposit at Bardia village (Lat. 22° 11′ N, Long. 69° 02′ E.), District Jamnagar. Location No. 29, 4·7 m., height above H.W.L., Sample No. 1(*a*). Submitted by S. K. Gupta.

Comment: Sample contains about 10% calcite.

TF-906, Late Quaternary, > 39000
(> 45000)

Coral from an emerged reef near Okha railway station (Lat. 22° 28′ N., Long. 69° 36′ E.), District Jamnagar, Location No. 27, 0·8 m. below M.S.L., Sample No. 1. Submitted by S. K. Gupta.

TF-907, Late Quaternary, $27050\,^{+1300}_{-1100}$

$$\left(27840\,^{+1340}_{-1210}\right)$$

Coral from an emerged reef near the village of Arama (Lat. 22° 26′ N., Long. 69° 05′ E.), District Jamnagar, Location No. 24, 3·5 m. above H.W.L., Sample No. 1. Submitted by S. K. Gupta.

TF-908, Late Quaternary, 5275 ± 105
(5430 ± 110)

Shells from a raised beach deposit near Bhimrana village (Lat. 22° 23′ N., Long. 69° 02′ E.), District Jamnagar, Location No. 23, 1 m. above H.W.L., Sample No. 1: Submitted by S. K. Gupta.

TF-911, Late Quaternary, 5075 ± 105
(5220 ± 105)

Coral from an emerged reef (only during low tide) near the port Salaya (Lat. 22° 22′ N., Long. 69° 39′ E.), District Jamnagar, Location No. 20, Sample No. 1. Submitted by S. K. Gupta.

TF-1014, Late Quaternary, 6010 ± 110
(6185 ± 115)

Coral from an emerged reef Okha (Lat. 22° 28′ N., Long. 69° 36′ E.), District Jamnagar. Field No. C.R. 1·2 m. above H.W.L., Sample No. 1. Submitted by M. V. A. Sastry, Geological Survey of India, Calcutta.

TF-1015, Late Quaternary, 4445 ± 105
(4575 ± 105)

Coral from an emerged reef on Dwarka Okha Road, District Jamnagar, Field No, C.R. 2, 1·6 m. above H.W.L., Sample No. 1. Submitted by M. V. A. Sastry.

Willington, Kerala, India

TF-965, Post-Glacial, 8080 ± 120
(8315 ± 125)

Root of a tree from Willington Island (Lat. 9° 58′ N., Long. 76° 15′ E.), District Cochin, Depth 16·75 m., Sample No. 1, Field No. 1, NaOH pretreatment was given. Submitted by Ev. Nielson, K.R.E.C., Surathkal.

1. Agrawal, D. P., Kusumgar, Sheela and Lal, D., *Curr. Sci.*, 1965, **34** (13), 394.

INCREASED ACCESSIBILITY OF SUBSTRATES TO ENZYMES IN STRAWBERRY LEAVES FED WITH IODOACETATE

M. E. YOUNIS*
The Botany School, University of Cambridge, England

ABSTRACT

Administration of (^{14}C) glucose to strawberry leaves either in water or in iodoacetate led to the generation of ^{14}C-labelled acids whose activities in the inner spaces of leaf cells and in the soaked-out inner space solutions were determined.

The magnitude of leakage of acids was higher in iodoacetate than in water and this was considered as a further evidence to support the previously suggested concept of increased accessibility, in the metabolic region, of substrate to enzymes.

INTRODUCTION

In strawberry leaves and radish root slices, low concentrations of iodoacetate increased the CO_2 output and induced characteristic changes in the metabolite content and in the leakage of certain metabolites from the tissues (Barker and Younis, 1965 *a*, *b*; Younis *et al.*, 1969).

Younis (1969) fed strawberry leaves with (^{14}C)-glucose either in water or in iodoacetate. The latter considerably increased the $^{14}CO_2$ output and the permeability of the plasmalemma and the tonoplast as was evident from the increased leakage from the free and inner spaces of leaves. The rate of leakage of sugars was dependent on their content in the inner space and was much higher in iodoacetate than in water.

The above-mentioned pronounced changes in cell permeability and metabolism led to the conclusion that iodoacetate increased the accessibility, in the metabolic region, of substrates to enzymes normally not saturated with their substrates and so the increased respiration could be explained on this basis.

It is the main objective of this paper to consider further results, which have been obtained during the work presented in a previous paper (Younis, 1969). The present results provide a further evidence for the concept of increased accessibility of substrates to enzymes in presence of iodoacetate.

MATERIALS AND METHODS

The methods of sampling and of feeding the strawberry leaves (var. Huxley) were precisely those of Barker and Younis (1965 *b*) and Younis (1969). A preliminary period of 2 days with the ends of petioles in water was allowed before feeding the leaves with (^{14}C)-glucose either in water or in 10^{-3} M iodoacetate. Samples were taken for analysis after 24 and 48 hours.

The determination of leakage was exactly as in Younis (1969). Briefly, in the two experiments carried out at 15° C, the leaves were cut into strips, dropped in water and subjected to two successive 5 mins. evacuations to ensure injection of water into the intercellular spaces. The strips were then soaked in a fresh aliquot of water for 2 hours under aerobic conditions: this allowed compounds to diffuse out.

The strips, after being soaked, were taken out, blotted and divided into 2 portions; one was extracted for keto-acids and the other for organic acids. The soaked-out inner space solution was also divided for measuring the activity of organic and keto-acids.

---

* Permanent Address: Department of Botany, Faculty of Science, University of A'in Shams, Abbassia, Cairo, U.A.R.

Killing of tissues and extraction of keto-acids were carried out as in Isherwood and Niavis (1956). For organic acids, the technique of Wager & Isherwood (1961) was used. The extracts were passed through columns containing 3 g. of Dowex 50 (× 8) cation exchange resin to retain inorganic actions & amino-acids; neutral compounds & anions passed through (Younis, 1969). The effluent was used directly without further fractionation for determination of organic acids.

The solvents used for chromatographic separation of pyruvate and α-ketoglutarate were those of Isherwood and Niavis (1956). The dried organic acid extracts were dissolved in water and an aliquot applied to the chromatogram. Two-directional chromatography, using the solvent systems of Pritchard (1959), gave good separation of citrate and malate.

Chromatograms were exposed to X-ray films and D19 *b* developer was used for 5-7 mins. development time. The radioactive spots of the acids were traced from the autoradiograms onto the chromatograms which were then cut and eluted. 0·2 ml. aliquots were pipetted onto planchettes and counted with a standard set-up including an end window Geiger tube. Countings were carried out to a standard deviation of 1% and all measurements were corrected for background count and paralysis.

RESULTS AND DISCUSSION

The present results indicate that some of the absorbed glucose was incorporated into pyruvate, α-ketoglutarate, citrate and malate; the latter 3 acids being most probably generated in the mitochondria through the tricarboxylic acid cycle reactions. The activity of the acids extracted from the leaf residues is considered as a measure of the inner space activity and is presented in Tables I and II together with the activity of acids in the soaked-out inner space solution.

The activity of pyruvate in the inner space was greater after 2 days in iodoacetate than in water and this accords with the increase in the total level of pyruvate shown by Barker and Younis (1965 *a*).

After 1 day, α-ketoglutarate activity was less in iodoacetate than in water but after two days the situation was reversed; 3-fold increase in activity being detected. This great increase in activity in α-ketoglutarate is rather difficult to reconcile with the fact that the total level of α-ketoglutarate showed a slight, if any increase in iodoacetate (Barker and Younis, 1965 *a*).

The leakage of α-ketoglutarate from the inner space was greater after 2 days in iodoacetate than after one day. To make the results (Tables I and II) better comparable, rate constants of leakage were calculated. For example, the rate constant of leakage of α-ketoglutarate after 1 day in iodoacetate (Table I).

$$= \frac{\text{soaked-out activity from inner space (counts/min./g. tissue/hr.)}}{\text{inner space activity (counts/min./g. tissue)}}$$

$$= \frac{4\cdot 5}{500} = 0\cdot 0090.$$

TABLE I

Activity in keto-acids (counts/min./g. tissue) and rate constant of leakage of acids in experiment 1*

Sample		Pyruvate	α-ketoglutarate	Rate constant of leakage
1 day iodoacetate, inner space	..	34	500	..
2 days ,,	..	83	6400	..
1 day water, inner space	..	32	1800	..
2 days ,,	..	40	2400	..
1 day iodoacetate, soaked-out inner space		00	9	0·0090
2 days ,,	..	00	100	0·0078
1 day water, soaked-out inner space	..	00	00	..
2 days ,,	..	00	00	..

* The term activity refers to radioactivity.

Thus, although the activity of α-ketoglutarate in the inner space of iodoacetate leaves varied from 500 (after 1 day) to 6,400 (after 2 days), yet the rate constants of leakage were much less variable (from 0·0090 to 0·0078). This obviously suggests that the rate of leakage of α-ketoglutarate was dependent on the inner space concentration.

The activities in citrate and malate in the inner space were lower in iodoacetate than in water (Table II). Again, this result does not agree with those of Barker and Younis (1965 *a*) who reported a small increase in the total level of citrate in iodoacetate. Leakage of citrate and malate from the inner space of the cut strips was operative and iodoacetate had an accelerating effect on the rate of leakage. On average, the rate constants of leakage for both acids were greater in iodoacetate than in water (Table II).

TABLE II

Activity in organic acids (counts/min./g. tissue) and rate constant of leakage of acids

Expt. No.	Sample	Citrate	Rate constant of leakage	Malate	Rate constant of leakage
1	1 day iodoacetate, inner space ..	990	..	6625	..
	2 days ,, ..	1700	..	5500	..
	1 day water, inner space ..	2000	..	13900	..
	2 days ,, ..	6700	..	20600	..
	1 day iodoacetate, soaked-out inner space ..	60	..	70	0·0053
	2 days ,, ..	51	0·0150	200	0·0182
	1 day water, soaked-out inner space ..	00	..	100	0·0036
	2 days ,, ..	100	0·0075	280	0·0068
2	2 days iodoacetate, inner space ..	480	..	9640	..
	2 days water, inner space ..	2530	..	29530	..
	2 days iodoacetate, soaked-out inner space ..	170	0·1770	2130	0·1105
	2 days water, soaked-out inner space ..	375	0·0741	975	0·0165

It is apparent that the rate of leakage differed in the two experiments. Thus, Younis (1969) stated that leaves which appear to be similar may differ greatly in permeability. He found that the response of respiration of mature leaves to iodoacetate was similar in several experiments. Nevertheless, varied extent of leakage in leaves held in water was noted.

The present results showing leakage of acids from the inner space are of great interest and doubtless provide a further evidence in support of the previously suggested concept that iodoacetate increased the permeability of the cell membranes and possibly of the cytoplasm and consequently increased the accessibility of substrates to enzymes in the metabolic region; thus the increased rate of respiration of the leaves (Younis, 1969).

To explain the above-mentioned abnormal changes in the activity of acids, it is noteworthy to refer to the work of Steward *et al.* (1956, 1958) who pointed out that the plant tissue is a heterogeneous system and it is entirely possible for two immiscible metabolic pools to co-exist and to contain the same substrate, which may be subject to different reactions or to similar reactions proceeding at different rates. Examples where the concentration of a metabolite was increasing while radioactivity was decreasing were given. Also compartmentation of acids of the tricarboxylic acid cycle was later demonstrated in corn roots (Maclennan *et al.*, 1963; Lips and Beevers, 1966 *a*, *b*; Steer and Beevers, 1967).

Thus, we can conclude that the contents of α-ketoglutarate, citrate and malate might be the sum of 2 separate pools, one of which is undergoing turnover in the tricarboxylic acid cycle and the other is not associated with the cycle. The changes in the content of the former pool might not affect the total content of these acids. However, these conclusions are rather speculative and call for further investigation.

ACKNOWLEDGMENTS

The author is indebted to Dr. J. Barker, F.R.S. and Dr. E. A. C. MacRobbie of the Botany School, Cambridge, for their generous encouragement and advice.

---

1. Barker, J. and Younis, M. E., *Jour. Exp. Bot.* 1965 *a*, **16**, 59.
2. — and —, *Ibid.*, 1965 *b*, **16**, 74.
3. Isherwood, F. A. and Niavis, C. A., *Biochem. Jour.*, 1956, **64**, 549.
4. Lips, S. H. and Beevers, H., *Plant. Physiol.*, 1966 *a*, **41**, 709.
5. — and —, *Ibid.*, 1966 *b*, **41**, 713.
6. Maclennan, D. H., Beevers, H. and Harley, J. L., *Biochem. Jour.*, 1963, **89**, 316.
7. Pritchard, G. G., "The effects of high oxygen tension on the respiratory metabolism of plant tissues," *Ph.D. Thesis*, Uuiversity of Cambridge, 1959.
8. Steer, B. T. and Beevers, H., *Plant Physiol.*, 1967, **42**, 1197.
9. Steward, F. C., Bidwell, R. G. S. and Yemm, E. W., *Nature*, 1956, **178**, 734, 789.
10. —, — and —, *Jour. Exp. Bot.*, 1958, **9**, 11.
11. Wager, H. and Isherwood, F. A., *Analyst*, 1961, **86**, 260.
12. Younis, A. E., Younis, M. E. and Gaber, M. A., *Plant & Cell Physiol.*, 1969, **10**, 95.
13. Younis, M. E., *New Phytol.*, 1969, **68**, 1059.

MANGANESE IN THE BOTTOM SEDIMENTS OF THE EASTERN PART OF BAY OF BENGAL

N. V. N. DURGAPRASADA RAO, M. RAMA MURTY AND M. POORNACHANDRA RAO
Geology Department, Andhra University, Waltair

INTRODUCTION

TWENTY bottom sediment samples covering different marine facies of the eastern part of Bay of Bengal (Lat. 7° 40′–20° 28′; Long. 92° 20′–97° 59′), which formed part of the collections made during a cruise on "Anton Brunn", a U.S. Oceanographic ship, in 1963 as a part of International Indian Ocean Expedition, were chemically analysed. The sediments were collected by dredge and snapper. As a part of the chemical study of the above sediments, this paper presents the results of the geochemical distribution of manganese in the clay-sized sediments, estimated colorimetrically by the persulphate method of Radar and Grimaldi (1961). The latitudinal zonation of carbonate content in the sediments of the eastern part of Bay of Bengal has already been reported by Durgaprasada Rao and Poornachandra Rao (1969).

RESULTS AND DISCUSSION

The individual values of manganese content show large variation from a minimum of 0·015% to a maximum of 0·34% (Table I). However, it is observed, that there is a regional variation in Mn content, a decrease in the concentration of this element towards south. Higher amounts of Mn are found in the terrigenous sediments of the northern part (above the northern extremity of Andaman Islands) when compared to the southern part characterised by high carbonate content (45%). This type of antipathic relationship between carbonate content and manganese has been observed by Wakeel and Riley (1960), and Subba Rao (1964) in marine sediments.

The regional variation in the manganese content might be due to two factors: (1) Control exercised by the continental geological formations and the amount of discharge by the rivers, and (2) the influence exerted by the carbonate content on Mn precipitation in the depositional environment. However, the influence of the second factor does not seem to be important. If it were so, in the southern part, where the sediments contain appreciable carbonate content (45%), the CO_2 from the decomposing organic matter will first attack the carbonate with the formation of bicarbonate which in turn, will tend to raise the pH (Manheim, 1961). As the high pH and the presence of small quantities of solid calcium carbonate form the most favourable environment for the non-reversible precipitation of manganese in the solid phase (Rankama and Sahama, 1950), one would naturally expect higher amounts of manganese. But contrary to this only small amounts of manganese are present in the sediments of the southern part.

TABLE I

Manganese in the bottom sediments of the eastern part of Bay of Bengal

Sample No.	Location	Depth in fathoms	$CaCO_3$ %	Mn %
South of Mergui Archipelago:				
17	7° 40′ N. 97° 08′ E	202	37	0·025
19	8° 29′ N. 97° 59′ E	27	47	0·015
20	9° 13′ N, 97° 51′ E	35	58	0·020
24	10° 36′ N, 95° 39′ E	1360	21	0·160
22 B	10° 40′ N, 97° 10′ E	160	50	0·015
Off Andaman Islands:				
28– I	11° 20′ N, 92° 40′ E	30	37	0·015
28–II	11° 35′ N, 92° 40′ E	25	26	0·016
28	11° 49′ N, 92° 52′ E	49	16	0·020
28 B	12° 01′ N, 92° 55′ E	27	41	0·025
29	12° 23′ N, 93° 20′ E	36	98	0·016
Irrawaddy Delta Shelf:				
30 A	13° 00′ N, 97° 41′ E	37	15	0·340
37	13° 28′ N, 97° 19′ E	39	6	0·050
40	15° 19′ N, 96° 24′ E	10	2	0·095
42	15° 08′ N, 94° 04′ E	16	17	0·040
43	15° 08′ N, 94° 04′ E	30	12	0·055
44	15° 30′ N, 93° 20′ E	31	10	0·065
Off Brahmaputra Delta:				
50 A	19° 27′ N, 92° 32′ E	550	9	0·050
48	19° 41′ N, 93° 08′ E	21	5	0·085
47 B	19° 50′ N, 92° 55′ E	17	2	0·060
47	20° 28′ N, 92° 20′ E	11	6	0·055

Considering the first factor mentioned above, the Brahmaputra and Irrawaddy river systems draining respectively through reworked sedimentary formations and certain well-marked alluvium-covered areas, separated by belts of hilly country mainly composed of gneisses and basic intrusives (0·25 to 0·09 Mn) with notable manganese content (Chhibber, 1934), join the Bay of Bengal in the north-east. The sedimentary detritus discharged by the above rivers is mostly deposited in the northern part of the area resulting in the increase of Mn content. The southern part is practically devoid of river contribution of sediments from the land area. Thus the high manganese content of the northern part sediments may be ascribed to the significant contribution from the source material through rivers compared to the southern part.

CONCLUSIONS

From the above results, it is concluded that the northern part of the area under investigation has different type of sediments from that of the southern part. As far as manganese content in the sediments of the eastern part of Bay of Bengal is concerned, it is inferred, that the source of the sediments and the amount of discharge of rivers played rather important role than the prevailing environmental influence.

ACKNOWLEDGEMENTS

The financial assistance from the C.S.I.R., New Delhi, is thankfully acknowledged. Our thanks are due to Dr. E. C. La Fond of U.S. Naval Undersea Centre, San Diego, California, for giving the samples utilised in the present investigation.

---

1. Chhibber, H. L. *et al.*, *Geology of Burma*, McMillan & Co., Ltd., London, 1934.
2. Durgaprasada Rao, N. V. N. and Poornachandra Rao, M., "Calcium carbonate in the sediments of the eastern part of the Bay of Bengal," *Curr. Sci.*, 1969, **38** (8), 195.
3. Frank, T. Manheim, "Geochemical profile in the Baltic Sea," *Geochim. et Cosmochim Acta*, 1961, **25**, 52.
4. Rodolfo, K. S., "Sediments of the Andaman Basin, North-eastern Indian Ocean," *Marine Geology*, 1969, **7**, 371.

HIGH TEMPERATURE K-FELSPAR IN A BASIC CHARNOCKITE OF KONDAVIDU, GUNTUR DISTRICT, ANDHRA PRADESH

M. S. SADASHIVAIAH AND G. V. SUBBARAYUDU

Department of Geology, Karnatak University, Dharwar-3, India

TWO hundred metres south-east of the village Kondavidu (Lat. N. 16° 15′ 40″; Long. E. 80° 15′ 50″) occurs coarse-grained basic charnockite forming hill-like mass. It shows dominantly granulitic and occasionally subophitic textures. In thin section it is composed of labradorite felspar, hypersthene, augite, K-felspar, quartz and biotite together with accessory apatite, magnetite and pyrite. The labradorite felspar ($An_{55-58\%}$) is seen mostly as twinned prisms and laths. The hypersthene occurs as anhedral plates with $2V_\alpha = 56°$ to $57°$, $(\gamma - \alpha) = 0 \cdot 017$, $\beta = 1 \cdot 702$ and pleochroic with α = salmon pink, β = pale yellowish-pink, and γ = pale green. Pale green augite having $2V_\gamma = 51°$, $\gamma : [001] = 40°$, $(\gamma - \alpha) = 0 \cdot 024$ and $\beta = 1 \cdot 680$ exhibits similar shape and size as that of hypersthene.

Microperthitic K-felspar belonging to the sanidine-anorthoclase group of the High albite series (Deer *et al.*, 1962) occurs as discrete crystals or patches within the labradorite felspar. The K-felspar has $\beta = 1 \cdot 522$ to $1 \cdot 523$ and variable optic axial angle ($2V_\alpha$) from 24° to 44° (determined on the universal stage). The optical characters have shown that the K-felspar grains having $2V_\alpha$ ranging from 24° to 34° are more abundant than the grains giving optic axial angles between 34° and 44°. The K-felspar is often found replaced by labradorite, and in such instances it occurs as patches within the latter. It constitutes 4·16% of the mode and it is found difficult to separate from the host rock for further investigation. However, the K-felspar takes the characteristic stain when the thin section of the basic charnockite is treated with sodium cobaltinitrite. The felspars show effects of strain. Anhedral quartz exhibits deformation lamellæ and strain shadows. Strongly pleochroic brick-red biotite is secondary after pyroxenes. Apatite occurs as prisms here and there. Magnetite and pyrite are seen as discrete grains and as granular inclusions in pyroxenes.

The basic charnockite of Kondavidu contains thin and elongated xenoliths of possibly semipelitic composition measuring about 0·3 × 6 metres tapering at both ends, and these xenoliths are composed of the mineral assemblage almost similar to the host rock; hence the xenoliths are charnockitic in character. The xenoliths which are charnockitic in character show some amount of variation in colour, texture and mineral assemblage. The greyish type is fine grained and foliated while the dark grey type is coarse grained and granulitic.

Fresh specimens of the basic charnockite and the ash-grey-coloured xenolith of charnockitic affinity of Kondavidu have been chemically analysed and the chemical analyses together with the calculated C.I.P.W. norm are given in Table I. The petrochemistry reveals that the basic charnockite is rich in iron, magnesia and lime, deficient in alumina, poor in silica, and impoverished in alkalies when compared with the analysed xenolith. These characters are also reflected in the calculated norm.

TABLE I
Chemical analyses

Specimen No.	K14	K332
SiO_2	48·60	62·35
TiO_2	0·70	0·65
Al_2O_3	14·69	16·36
Fe_2O_3	4·96	1·20
FeO	11·78	5·98
MnO	0·17	0·08
MgO	5·50	1·66
CaO	10·78	3·64
Na_2O	1·57	4·90
K_2O	0·77	2·95
H_2O	0·52	0·30
Total	100·04	100·07
	C.I.P.W. norm	
Q	2·46	8·94
or	5·00	17·79
ab	13·10	41·39
an	30·58	13·90
di	19·21	3·32
hy	20·68	11·49
mt	7·19	1·86
il	1·37	1·37

K 14. Basic charnockite, Kondavidu, Anal.: G. V. Subbarayudu.

K 332. Fine grained xenolith from the basic charnockite (K 14), Kondavidu, Anal. : G. V. Subbarayudu.

Though it is difficult to surmise, precisely, the composition of the parent material of the xenolith, it is possibly a semipelitic sediment rich in silica, alumina and alkalies and has derived its present texture and mineral assemblage due to metamorphism caused by the magma which has given rise to the basic charnockite of the area. It is evident that the basic charnockite, though metamorphic in character in the present state, its parentage is undoubtedly igneous.

The occurrence of the high temperature K-felspar of the sanidine-anorthoclase isomorphous series (High albite series) in the basic charnockite is of great importance in view of the fact that the sanidine-bearing rocks belonging to the sanidinite facies are restricted to xenoliths in lavas, thermally metamorphosed contact rocks, dykes, volcanic breccias and in the vicinity of near surface intrusions (Turner and Verhoogen, 1962). So far there is no recorded instance of the occurrence of high temperature K-felspar belonging to the sanidine-anorthoclase isomorphous series in charnockites. High temperature K-felspar in the basic charnockite of Kondavidu has probably originated due to the assimilation of the semipelitic sediment by the parent magma of the basic charnockite when the potash constituent of the sediment while getting incorporated has crystallized to give rise to the high temperature form of the K-felspar belonging to the sanidine-anorthoclase isomorphous series under the physico-chemical conditions similar to the sanidinite facies.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. R. A. Howie for the critical examination of the charnockite and for useful suggestions. Thanks are also due to the University Grants Commission for the award of a research scholarship to one of the authors (G. V. S.).

---

1. Deer, W. A., Howie, R. A. and Zussman, J., *Rock Forming Minerals*, Longmans, 1962, **4**.
2. Turner, F. J. and Verhoogen, J., *Igneous and Metamorphic Petrology*, Allied Paciphic Private Ltd., Bombay, 1962.

LETTERS TO THE EDITOR

ROTATIONAL ANALYSIS OF A $^3\Pi_{0,1}$–$X^1\Sigma$ SYSTEM OF AlBr

THE emission spectrum of AlBr is well known to consist of two discrete band systems in the regions λ 3000–λ 2750 and λ 4370–λ 4040. From a detailed study of the rotational structure of some of the bands of the ultraviolet system, Jennergren[1] (1948) showed that the transition is $A^1\Pi$–$X^1\Sigma$. The bands in the region λ 4370–λ 4040 were first reported by Sharma[2] in a transformer discharge using the dispersion of Hilger E_1 Spectrograph with glass optics. The bands were analysed on the basis of two sub-systems arising from $^3\Pi_{0,1}$–$X^1\Sigma$ transitions by analogy with similar systems of AlCl and AlI. From the observed head origin intervals in the bands of $^3\Pi_1$–$X^1\Sigma$ sub-system, approximate values of the rotational constants of $^3\Pi_1$ state were determined.

In our recent investigations on the spectra of III-A group halide molecules, we have photographed the visible emission band spectrum of AlBr as excited in a R.F. discharge from a 1/2 k.W. oscillator in the second order of 21 ft. Cancave Grating Spectrograph (dispersion 0·625 Å/mm.). The (0, 0) bands of the two sub-systems were well resolved and found suitable for a detailed study of the rotational analysis. The rotational structure of $^3\Pi_0$–$X^1\Sigma$ sub-band revealed the expected two branches P and R, while the $^3\Pi_1$–$X^1\Sigma$ sub-band showed an intense Q branch, in addition to P and R branches. The R lines of the $^3\Pi_0$–$X^1\Sigma$ and the Q and R lines of $^3\Pi_1$–$X^1\Sigma$ bands were split up into two lines of almost equal intensity due to the bromine isotope effect at high J values.

The J numbering in the P and R branches of $^3\Pi_0$–$X^1\Sigma$ sub-band is fixed by a comparison of the observed $\Delta_2F''(J)$ values with those determined from the rotational constants of $X^1\Sigma$ state, reported by Jennergren. Similarly, the J numbering in the P, Q and R branches of the $^3\Pi_1$–$X^1\Sigma$ sub-band is fixed from a comparison of the observed $\Delta_1F''(J)$ values with those determined from the rotational constants of $X^1\Sigma$ state. The J assignments in both the bands were confirmed from a detailed study of the bromine isotope effect. The J numbering in the P and R branches of the $^3\Pi_0$–$X^1\Sigma$ sub-band is shown in Fig. 1. The band origins and the rotational constants of the $V' = 0$ level of the $^3\Pi_0$ and $^3\Pi_1$ states as determined from the rotational analysis are given in Table I.

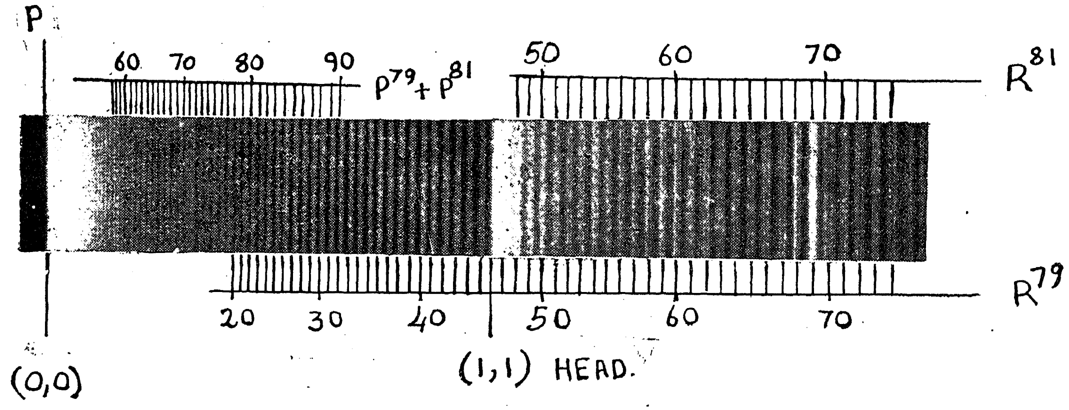


FIG. 1

TABLE I

Rotational constants of $^3\Pi_0$ and $^3\Pi_1$ states of $AlBr^{79}$

State	B_0 in cm.$^{-1}$	I_0	r_0
$^3\Pi_0$	0·1643	$170{\cdot}36 \times 10^{-40}$ gm./cm.^{2}	$2{\cdot}259 \times 10^{-8}$ cm.
$^3\Pi_1$	0·1646	$170{\cdot}05 \times 10^{-40}$ gm./cm.^{2}	$2{\cdot}257 \times 10^{-8}$ cm.

$$\nu_0^{(0,0)} \text{ of } {}^3\Pi_0\text{–}X^1\Sigma = 23062{\cdot}70 \text{ cm.}^{-1}$$

$$\nu_0^{(0,0)} \text{ of } {}^3\Pi_1\text{–}X^1\Sigma = 23792{\cdot}40 \text{ cm.}^{-1}$$

Spectroscopy Lab., A. LAKSHMINARAYANA.
Department of Physics, P. B. V. HARANATH.
Andhra University,
Waltair, *October* 30, 1969.

---

1. Jennergren, C. G., *Ark. Mat. Rstr. Fys.*, 1941, **35 A**, No. **22**.
2. Sharma, D., *Astrophys. J.*, 1951, **113**, 219.

FORCE CONSTANTS, MEAN AMPLITUDES OF VIBRATION AND BASTIANSEN-MORINO SHRINKAGES OF $TaCl_6^{-1}$ ION

RECENTLY, the fundamental frequencies for $TaCl_6^{-1}$ ion have been assigned by Beattie *et al.*[1] The ion belongs to O_h symmetry, has three (ν_1, ν_2 and ν_5) Raman active, two (ν_3 and ν_4) infrared active and one (ν_6) inactive frequencies. These are $\nu_1 = 380$, $\nu_2 = 300$, $\nu_3 = 328$, $\nu_4 = 160$, $\nu_5 = 181$ and $\nu_6 = 128$ cm.$^{-1}$ The inactive fundamental frequency has been calculated using Wilson's rule $\nu_5 = \sqrt{2}\ \nu_6$.

Wilson's G–F matrix method has been used to evaluate the force constants using G.V.F.F. The matrix elements of F and G matrices and symmetry co-ordinates are the same as those of Pistorius.[2] Earlier workers in the field have used different arbitrary assumptions for the solution of f_{1u} mode of vibration, in the case of XY_6 type of molecules and ions, which led to two-dimensional equation. Recently, Peacock and Müller[3] have indicated a method to overcome this difficulty. Using this method we have evaluated all the seven independent force constants uniquely. The calculated force constants are shown in Table I.

TABLE I

Force constants of $TaCl_6^{-1}$ ion in 10^5 dyne cm.$^{-1}$

f_r	1·96251
f'_{rr}	0·09475
f_{rr}	0·18926
$f_{r\alpha}-f''_{r\alpha}$	0·04812
$f_\alpha-f'''_{\alpha\alpha}$	0·17098
$f_{\alpha\alpha}-f''_{\alpha\alpha}$	−0·000014
$f'_{\alpha\alpha}-f'''_{\alpha\alpha}$	0·000008

Again the method of Peacock and Müller[3] has been used to evaluate the symmetrized mean amplitude matrix Σ for f_{1u} mode of vibration, which is related to mean amplitude of vibration and Bastiansen-Morino shrinkages. The mean amplitudes of vibration u(X—Y), u(Y...Y short), and u(Y...Y long) have been evaluated at two different temperatures 0° K and 298° K. The interatomic distance Ta-Cl = 2·6468 Å has been calculated by Badgers relation[4] and used to evaluate the Bastiansen-Morino shrinkages ∂(Y...Y short) and ∂(Y...Y long) at 0° K and 298° K. The mean amplitudes of vibration and Bastiansen-Morino shrinkages have been tabulated in Table II.

TABLE II

Mean amplitudes of vibration (u) *and Bastiansen-Morino shrinkages* (∂) *in Å units for $TaCl_6^{-1}$ ion*

Quantities		T = 0° K	T = 298° K
u (X—Y)	..	0·041784	0·050155
u (Y···Y short)	..	0·067874	0·105390
u (Y···Y long)	..	0·054295	0·065936
∂ (Y···Y short)	..	0·000384	0·001078
∂ (Y···Y long)	..	0·001640	0·004890

These have not yet been experimentally determined from electron diffraction studies and therefore they may prove to be useful if and when such a work is carried out.

The authors express their sincere thanks to Prof. S. Lokanathan for his interest in this work. One of us (M. L. M.) is also grateful to U.G.C. for the award of a Post-graduate Research Scholarship.

Department of Physics, M. N. AWASTHI.
University of Jodhpur, M. L. MEHTA.
Jodhpur (Rajasthan), *November* 1, 1969.

---

1. Beattie, I. R., Gilson, T. R. and Ozin, G. A., *J. Chem. Soc.*, 1968, **A**, 2765.
2. Pistorius, C. W. F. T., *J. Chem. Phys.*, 1958, **29**, 1328.
3. Peacock, C. J. and Müller, A., *J. Mole. Spectry.*, 1968, **26**, 454.
4. Badger, R. M., *J. Chem. Phys.*, 1934, **2**, 128; *Ibid.*, 1935, **3**, 710.

EFFECT OF ACID LEACHING ON ALPHA-INDEX OF SIZE FRACTIONS OF MONAZITE AND ZIRCON SANDS

QUITE often the alpha-index reported for a mineral does not represent the true activity, and the high values obtained result in low age values. Hence the effect of acid leaching on radioactivity of minerals like monazite and zircon has been studied by many earlier workers.[1,2] In the present investigation, the effect of acid leaching on alpha-index of naturally occurring size fractions of beach placers of monazite and zircon, collected from Manavalakurichi area in Tamil Nadu (Madras State), India is studied using a scintillation counter with a view to determine their ages by lead-alpha method. All the samples are crushed to the same size and the studies are made by adding dilute HCl (1 : 4) to the $\leqslant 40\,\mu$ size sample and treating it for 48 hours,

TABLE I

Size fraction (in microns)	Monazite			Zircon		
	Initial activity (alphas/mg/.hr.) (10^3)	Activity after acid treatment (alphas/mg./hr.) (10^3)	Percentage drop in activity	Initial activity (alphas/mg./hr.)	Activity after acid treatment (alphas/mg./hr.)	Percentage drop in activity
Total	12·3	10·4	15	194	185	5
>315	12·0	10·2	15	169	160	4
315–250	12·0	10·1	16	176	165	6
250–160	13·1	10·9	17	171	165	4
160–125	10·8	10·0	8	222	190	14
125–090	11·7	10·4	11	342	262	23
<090	12·3	10·2	17	438	390	11

The natural percentage abundance of these minerals and their order of purity along with several others from this area are reported in our earlier communication.[3] The index is accurate to ± 2%.

From Table I it can be seen that acid leaching has caused appreciable change in alpha activity in certain size fractions of both monazite and zircon. In monazite, for majority of size fractions the drop in activity is around 16%, and for 160–125 μ size, a minimum of 8%. After acid leaching, the alpha-index for all the size fractions in this mineral is found to be of the same order, thereby indicating that the slight variation observed before leaching is mainly due to surfacial contamination.

In zircons, higher activity is exhibited by the finer sizes, before acid treatment. However, as Silver and Deutsch[2] have pointed out, in zircons, though a significant proportion of both uranium and thorium is presumably held within the zircon structure as the cations U^{4+} and Th^{4+}, significant amounts of these two elements might also be present in zircon as leachable uranothorite. This is evident from the large drop (11–23%) exhibited by these finer sizes as compared to 4–6% in coarser sizes. However the residual activities are still high and clearly show that their activity has been to a large extent uniformly distributed throughout the crystal structure of the mineral. In these size fractions, the tendency for the alpha activity to increase inversely with the size of the particle can be noticed. A similar effect has been observed by Quinn *et al.*[4] in their lead-alpha studies on zircons from Cowesett granite where the alpha activity is found to increase inversely with crystal size, for three sizes considered.

Dept. of Physics, C. S. SASTRI.
Indian Institute of V. SIVARAMAKRISHNAN.
Technology,
Madras-36, *December* 8, 1969.

1. Tilton, G. R. and Nicolayson, L. O., *Geochim. Gosmochim. Acta*, 1957, **11**, 28.
2. Silver, L. T. and Deutsch, S., *J. Geol.*, 1963, **71**, 721.
3. Sastry, C. S. and Sivaramakrishnan, V., *Curr. Sci.*, 1968, **37**, 550.
4. Quinn, A. W., Jaffe, H. W., Smith, W. L. and Waring, C. L., *Am. J. Sci.*, 1957, **255**, 547.

THERMAL DECOMPOSITION OF CADMIUM CHROMATE

THE thermal decomposition of cadmium reineckate, $[Cd(SCN_2H_4)_2]$ $[Cr(NCS)_4(NH_3)_2]_2$ is reported to give a mixture of cadmium oxide and the spinel, cadmium chromite, $CdCr_2O_4$, at about 950° C.[1] Solid state reaction of CdO and Cr_2O_3 for the formation of the spinel requires heating the oxide mixtures at 800–900° for several hours. We report here the facile and quantitative formation of the spinel at much lower temperatures *via* the thermal decomposition of cadmium chromate.

Cadmium chromate was prepared by two different methods: (*i*) 25 mM of CrO_3 was dissolved in about 25 ml. of water. To this solution was added in small quantities 25 mM of CdO. The resulting solution was evaporated to a small volume and kept in a vacuum desiccator over conc. H_2SO_4 at room temperature. Yellow crystals of anhydrous $CdCrO_4$ separated out. The crystals were collected in a filter, washed with acetone and dried (Found Cd, 49·32%; Cr, 22·71%, required for $CdCrO_4$, Cd, 49·20%; Cr, 22·77%). (*ii*) $CdCrO_4$ was also obtained by grinding for 20–30 minutes equimolar proportions of CdO and CrO_3 in an agate mortar and pestle. The X-ray powder patterns for both the samples were the same. The *d* spacings determined using a 114·6 mm. diameter camera and CuK_α radiation were: 4·66 (*s*), 4·24 (*s*), 3·89 (*w*), 2·75 (*s*), 2·54 (*s*), 2·15 (*s*), 1·93 (*m*), 1·83 (*m*), 1·71 (*w*), 1·62 (*w*), 1·53 (*s*), The course of decomposition of $CdCrO_4$ was investigated by thermogravimetry and was supplemented by chemical and X-ray elucidation of nature of products. Exactly about 500 mg. samples of $CdCrO_4$ (– 200 mesh) were taken in a platinum crucible and heated continuously from room temperature at a linear rate of 6° per minute in a Stanton Model HT-SM thermorecording balance. The weight change *vs.* temperature (TG) and the rate of weight change *vs.* temperature (DTG) curves are shown in Fig. 1. Decomposition began at 570° and was complete at 700°; the DTG curve indicates only a one-step decomposition. The total weight loss on thermal decomposition was found to be 10·5% which indicated that all the Cr(VI) in the original chromate had transformed to Cr (III) with loss of oxygen. [Expected oxygen weight loss accompanying Cr(VI) to Cr(III) change in $CdCrO_4$ is 10·51%.] The X-ray powder pattern of the final product showed lines characteristic of CdO and $CdCr_2^{III}O_4$. On leaching the product with 2 N H_2SO_4, the cadmium was found to be distributed in the solution and insoluble phases in the ratio of 1 : 1 and all the chromium was found only in the insoluble phase. The insoluble phase gave X-ray powder pattern characteristic of only $CdCr_2O_4$, and was opened up by fusion with sodium peroxide and analyzed for cadmium and chromium (Found Cd, 40·19%; Cr, 37·21% required for $CdCr_2O_4$, Cd, 40·07%; Cr, 37·09%). Thus, the decomposition of cadmium chromate (VI) yields CdO and the spinel $CdCr_2O_4$ following the overall stoichiometry: $2CdCrO_4 \rightarrow CdO + CdCr_2O_4 + 1\frac{1}{2}\ O_2$. The ready formation of the spinel during the decomposition of $CdCrO_4$ is ascribed to the cadmium and chromium being present in a perfectly blended state, almost at a molecular level, a condition which is not achieved in a synthetic mixture of Cr_2O_3 and CdO.

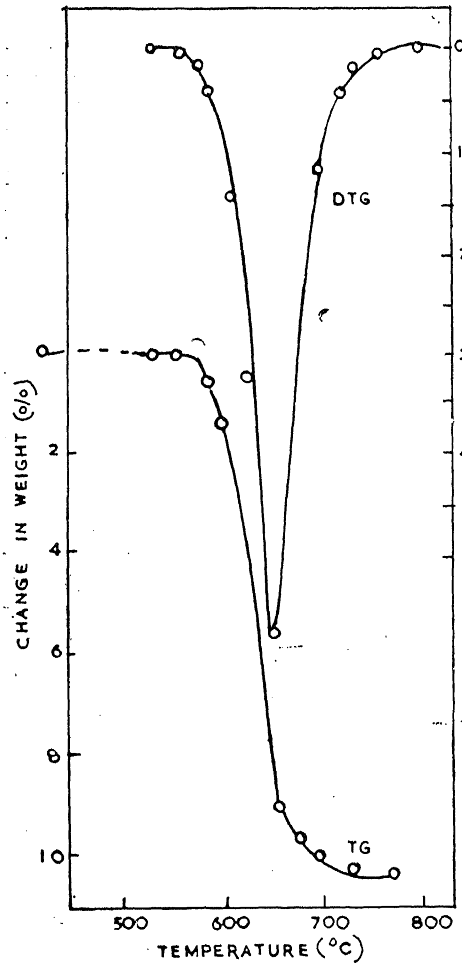


FIG. 1. T.G. and DTG curves of $CdCrO_4$. Rate of heating = 6° /min.

The thermogravimetric results were utilized to find out the order of the reaction and the activation energy by making use of Freeman-Carroll plot[2] (Fig. 2). The order of the

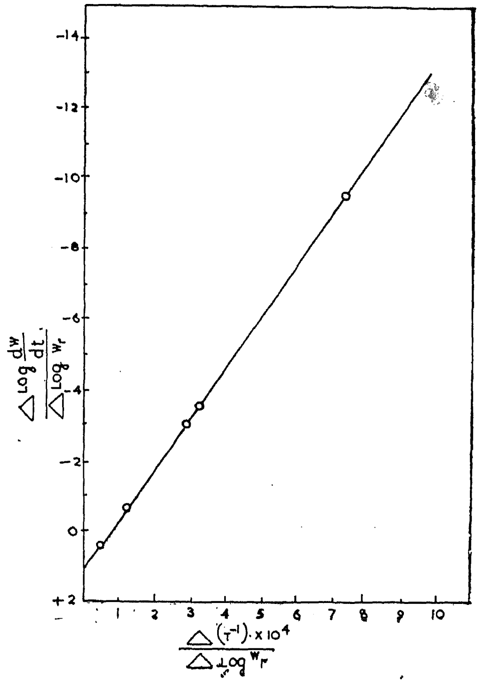


FIG. 2. Freeman-Carrol plot: Kinetics of the decomposition of $CdCrO_4$.

TABLE I

Size fraction (in microns)	Monazite			Zircon		
	Initial activity (alphas/mg/.hr.) (10^3)	Activity after acid treatment (alphas/mg./hr.) (10^3)	Percentage drop in activity	Initial activity (alphas/mg./hr.)	Activity after acid treatment (alphas/mg./hr.)	Percentage drop in activity
Total	12·3	10·4	15	194	185	5
>315	12·0	10·2	15	169	160	4
315–250	12·0	10·1	16	176	165	6
250–160	13·1	10·9	17	171	165	4
160–125	10·8	10·0	8	222	190	14
125–090	11·7	10·4	11	342	262	23
<090	12·3	10·2	17	438	390	11

The natural percentage abundance of these minerals and their order of purity along with several others from this area are reported in our earlier communication.[3] The index is accurate to ± 2%.

From Table I it can be seen that acid leaching has caused appreciable change in alpha activity in certain size fractions of both monazite and zircon. In monazite, for majority of size fractions the drop in activity is around 16%, and for 160–125 μ size, a minimum of 8%. After acid leaching, the alpha-index for all the size fractions in this mineral is found to be of the same order, thereby indicating that the slight variation observed before leaching is mainly due to surfacial contamination.

In zircons, higher activity is exhibited by the finer sizes, before acid treatment. However, as Silver and Deutsch[2] have pointed out, in zircons, though a significant proportion of both uranium and thorium is presumably held within the zircon structure as the cations U^{4+} and Th^{4+}, significant amounts of these two elements might also be present in zircon as leachable uranothorite. This is evident from the large drop (11–23%) exhibited by these finer sizes as compared to 4–6% in coarser sizes. However the residual activities are still high and clearly show that their activity has been to a large extent uniformly distributed throughout the crystal structure of the mineral. In these size fractions, the tendency for the alpha activity to increase inversely with the size of the particle can be noticed. A similar effect has been observed by Quinn *et al.*[4] in their lead-alpha studies on zircons from Cowesett granite where the alpha activity is found to increase inversely with crystal size, for three sizes considered.

Dept. of Physics, C. S. SASTRI.
Indian Institute of V. SIVARAMAKRISHNAN.
Technology,
Madras-36, *December* 8, 1969.

1. Tilton, G. R. and Nicolayson, L. O., *Geochim. et Gosmochim. Acta*, 1957, **11**, 28.
2. Silver, L. T. and Deutsch, S., *J. Geol.*, 1963, **71**, 721.
3. Sastry, C. S. and Sivaramakrishnan, V., *Curr. Sci.*, 1968, **37**, 550.
4. Quinn, A. W., Jaffe, H. W., Smith, W. L. and Waring, C. L., *Am. J. Sci.*, 1957, **255**, 547.

THERMAL DECOMPOSITION OF CADMIUM CHROMATE

THE thermal decomposition of cadmium reineckate, $[Cd(SCN_2H_4)_2]\ [Cr(NCS)_4(NH_3)_2]_2$ is reported to give a mixture of cadmium oxide and the spinel, cadmium chromite, $CdCr_2O_4$, at about 950° C.[1] Solid state reaction of CdO and Cr_2O_3 for the formation of the spinel requires heating the oxide mixtures at 800–900° for several hours. We report here the facile and quantitative formation of the spinel at much lower temperatures *via* the thermal decomposition of cadmium chromate.

Cadmium chromate was prepared by two different methods: (*i*) 25 mM of CrO_3 was dissolved in about 25 ml. of water. To this solution was added in small quantities 25 mM of CdO. The resulting solution was evaporated to a small volume and kept in a vacuum desiccator over conc. H_2SO_4 at room temperature. Yellow crystals of anhydrous $CdCrO_4$ separated out. The crystals were collected in a filter, washed with acetone and dried (Found Cd, 49·32%; Cr, 22·71%, required for $CdCrO_4$, Cd, 49·20%; Cr, 22·77%). (*ii*) $CdCrO_4$ was also obtained by grinding for 20–30 minutes equimolar proportions of CdO and CrO_3 in an agate mortar and pestle. The X-ray powder patterns for both the samples were the same. The *d* spacings determined using a 114·6 mm. diameter camera and CuK_α radiation were: 4·66 (*s*), 4·24 (*s*), 3·89 (*w*), 2·75 (*s*), 2·54 (*s*), 2·15 (*s*), 1·93 (*m*), 1·83 (*m*), 1·71 (*w*), 1·62 (*w*), 1·53 (*s*), The course of decomposition of $CdCrO_4$ was investigated by thermogravimetry and was supplemented by chemical and X-ray elucidation of nature of products. Exactly about 500 mg. samples of $CdCrO_4$ (– 200 mesh) were taken in a platinum crucible and heated continuously from room temperature at a linear rate of 6° per minute in a Stanton Model HT-SM thermorecording balance. The weight change *vs.* temperature (TG) and the rate of weight change *vs.* temperature (DTG) curves are shown in Fig. 1. Decomposition began at 570° and was complete at 700° ; the DTG curve indicates only a one-step decomposition. The total weight loss on thermal decomposition was found to be 10·5% which indicated that all the Cr(VI) in the original chromate had transformed to Cr (III) with loss of oxygen. [Expected oxygen weight loss accompanying Cr(VI) to Cr(III) change in $CdCrO_4$ is 10·51%.] The X-ray powder pattern of the final product showed lines characteristic of CdO and $CdCr_2^{III}O_4$. On leaching the product with 2 N H_2SO_4, the cadmium was found to be distributed in the solution and insoluble phases in the ratio of 1 : 1 and all the chromium was found only in the insoluble phase. The insoluble phase gave X-ray powder pattern characteristic of only $CdCr_2O_4$, and was opened up by fusion with sodium peroxide and analyzed for cadmium and chromium (Found Cd, 40·19% ; Cr, 37·21% required for $CdCr_2O_4$, Cd, 40·07% ; Cr, 37·09%). Thus, the decomposition of cadmium chromate (VI) yields CdO and the spinel $CdCr_2O_4$ following the overall stoichiometry : $2CdCrO_4 \rightarrow CdO + CdCr_2O_4 + 1\frac{1}{2}\ O_2$. The ready formation of the spinel during the decomposition of $CdCrO_4$ is ascribed to the cadmium and chromium being present in a perfectly blended state, almost at a molecular level, a condition which is not achieved in a synthetic mixture of Cr_2O_3 and CdO.

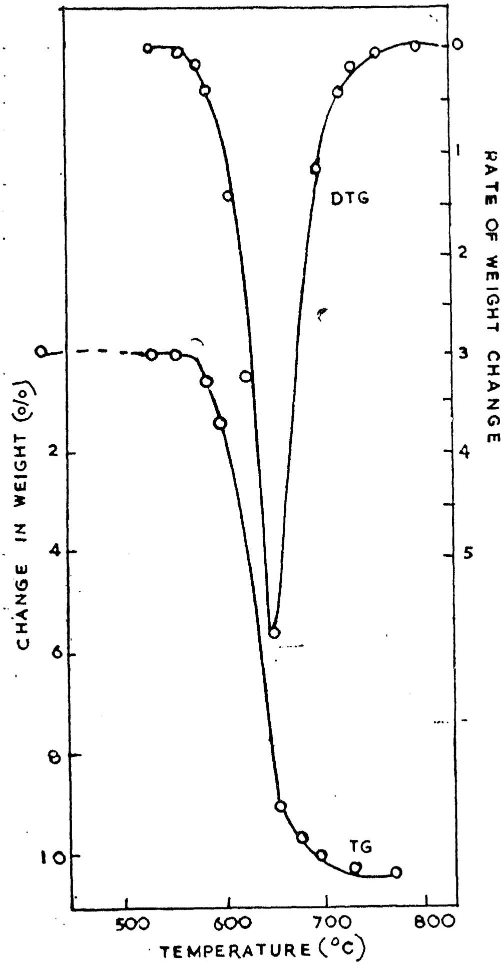


FIG. 1. T.G. and DTG curves of $CdCrO_4$. Rate of heating $= 6^{\circ}$/min.

The thermogravimetric results were utilized to find out the order of the reaction and the activation energy by making use of Freeman-Carroll plot[2] (Fig. 2). The order of the

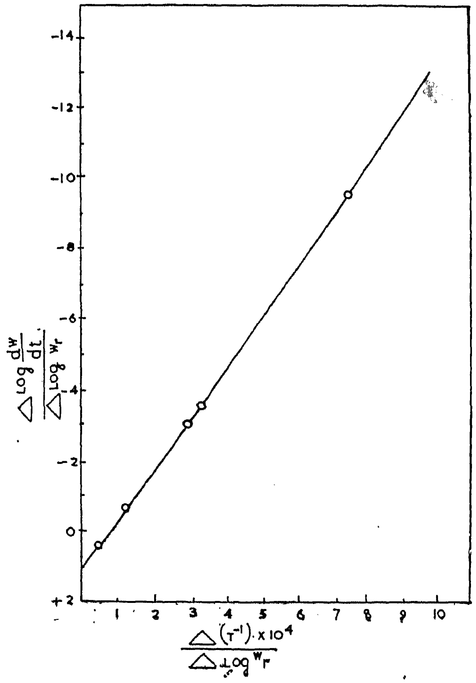


FIG. 2. Freeman-Carrol plot: Kinetics of the decomposition of $CdCrO_4$.

reaction is found to be one and the activation energy determined to be 68·1 Kcals/mole.

Dept. of Chemistry, M. RAMAKRISHNA UDUPA.
Indian Institute of P. V. HARIHARAN.
Technology, G. ARAVAMUDAN.
Madras-36, *November* 25, 1969.

---

1. Duval, C., *Inorg. Thermograv. Analysis*, Elsevier, II Ed., 1963, p. 497.
2. Freeman, E. and Carroll, B., *J. Phys. Chem.*, 1958, **62**, 394.

EFFECT OF REDUCTION ON THE ADSORPTION OF HYDROGEN ON NICKEL-ALUMINA CATALYST

WITH the silica supported nickel catalysts, Schuit and de Boer[1,2] found activated adsorption of hydrogen to occur on a partially oxidized but not on a thoroughly reduced nickel surface. On successive reduction of the catalyst the extent of fast adsorption increased at the expense of the slow adsorption that followed the initial fast adsorption. Since the fast adsorption mainly takes place on a completely reduced metal surface it was decided to find out the effect of reduction on the metal surface area of nickel-alumina catalyst and hence on the hydrogen adsorption on the catalyst.

In the present investigation a co-precipitated nickel-alumina catalyst, containing 30·1% of nickel, has been used. Three different amounts of the same catalyst (labelled as I, II and III) were subjected to different reduction treatments, the details of which are shown in Table I. After the reduction, the catalyst was evacuated at 390° C. at 10^{-6} cm. Hg and cooled to 19° C. Hydrogen adsorption isotherm measurements were carried out at this temperature using a conventional constant volume adsorption system. Nickel surface areas were calculated from the isotherms, assuming that the amount of gas adsorbed at 10 cm. Hg represented a monolayer[3] and on the basis that each nickel atom in the surface adsorbs one hydrogen atom and that each hydrogen atom occupies 6·5 A^2 of the surface.[4]

TABLE I

Comparison of catalysts I, II and III

Description	Catalysts		
	I	II	III
Percentage of nickel content (by analysis)	30·1	30·1	30·1
Weight of nickel in the catalyst (gram)	0·743	0·849	0·854
Reduction temperature (°C.)	390	490	390
Reduction time (Hours) ..	12	12	72
BET surface area (m^2/g.) ..	163·7	118·0	155·1
Metal surface area (m^2/g.) ..	8·74	12·09	12·27
Adsorption of hydrogen at 19°C. and at 10 cm. eq. pr (ml. NTP)	9·0	14·2	14·5
Specific adsorption capacity (per gram of nickel) ml NTP	12·11	16·70	16·97

From Table I, it is seen that the specific adsorption capacities of the catalysts are in the order catalyst III > catalyst II > datalyst I. The high adsorption capacity of catalyst III may be due to a longer reduction period. It must be noted in this connection that even though catalyst II was reduced only for 12 hours, as in the case of catalyst I, it has a specific adsorption capacity (16·7 ml.) comparable to that of catalyst III (16·97 ml.) reduced for 72 hours. This may be attributed to the higher temperature of reduction, *viz.*, 490° C. at which the catalyst is more easily reduced and the metal surface area is increased.

The three catalysts can also be compared on the basis of their adsorption capacities at different temperatures as shown in Table II.

TABLE II

Effect of temperature on hydrogen adsorption on nickel-alumina

(Volume adsorbed ml. NTP)

Temperature (°C.)	Catalysts					
	I		II		III	
	q_1	$(q_{100}-q_1)$	q_1	$(q_{100}-q_1)$	q_1	$(q_{100}-q_1)$
200	9·84	1·00	13·52	1·67	13·54	1·85
30	6·34	2·06	10·34	1·96	12·72	2·22
0	5·83	2·27	9·83	2·35	10·53	2·50

q_1 = Adsorption at the first minute from the time of addition of gas (represents the fast adsorption).

q_{100} = Adsorption at the 100th minute from the time of addition of gas.

$(q_{100}-q_1)$ = The difference between the amount of gas adsorbed at the 100th minute and the first minute (represents the slow adsorption).

Catalysts II and III have a high q_1 value (13·52 and 13·54 ml. respectively) showing a high adsorption capacity due to the greater number of free metal atoms. In all the three catalysts, the fast adsorption (q_1) increases with temperature whereas the slow adsorption, $(q_{100}-q_1)$ decreases. This observation indicates that the sites active for high-temperature slow adsorption and lower-temperature fast adsorption are less.[5] The decrease in the slow adsorption from 2·27 ml. at 0° C. to 1·00 ml. at 200° C. is striking in the case of catalyst I (the difference being 1·27 ml.) when compared to catalysts II and III where $(q_{100}-q_1)$ differences are only 0·68 and 0·65 ml. respectively. This shows that in the case of catalyst I, which is less reduced compared to catalysts II and III, more unreduced surface nickel atoms are taking part in the fast adsorption at higher temperatures.

Though the q_1 values do not throw any definite light on the nature of the surface, they do indicate a trend that the highly reduced surface shows a higher fast adsorption and a lower slow adsorption than an incompletely reduced catalyst.

One of us (S. N.) wishes to thank the Ministry of Education, Government of India, for a Research Fellowship.

Dept. of Chemistry, S. NARAYANAN.*
Loyola College, L. M. YEDDANAPALLI.
Madras, *November* 29, 1969.

---

* Presently at Department of Chemistry, St. Joseph's College, West Hartford, Conn. 06117, U.S.A.

1. Schuit, G. C. A. and de Boer, N. H., *Rec. Trav., Chim.*, 1951, **70**, 1067.
2. — and —, *Nature*., 1951, **168**, 1040.
3. Taylor, W. F., Yates, D. J. C. and Sinfelt, J. H., *J. Phys. Chem.*, 1964, **68**, 2962.
4. Klemperer, D. F. and Stone, F. S., *Proc. Roy. Soc. (Lond.)*, 1958, **243 A**, 375.
5. Ramasubramanian, N. and Yeddanapalli, L. M., *Can. J. Chem.*, 1963, **41**, 68.

KINETICS OF THE OXIDATION OF MANDELIC ACID BY IODOSOBENZENE DIACETATE

LEAD tetraacetate is known to cleave α-hydroxy acids.[1,2] Lead tetraacetate and iodosobenzene diacetate are known to be very similar in their action on 1 : 2 diols.[3] As the reactions between α-hydroxy acids and iodosobenzene diacetate have not been kinetically investigated so far, we present in this communication the preliminary observations of our experiments on the kinetics and rate-law in the oxidation of mandelic acid by iodosobenzene diacetate. The oxidation reaction was carried out in binary solvent mixtures of acetic acid and water and the analytical procedure used was essentially that of Cordner and Pausacker,[4] which consisted of the iodometric estimation of unreacted iodosobenzene diacetate at various time intervals. The reactions were carried out both under pseudo first-order conditions and also under second-order conditions. The reaction is of a clean first order in iodosodiacetate and also in mandelic acid (Table I).

TABLE I

Second-order constants for the oxidation of mandelic acid by iodosobenzene diacetate

Temp. 40° C. Solvent: 70% $\overline{\text{HO}}$Ac

[Iodosodiacetate] (M)	[Mandelic acid] (M)	$k_2 \times 10^3$ litre mole^{-1} sec.$^{-1}$
0·005328	0·01464	6·12
0·005413	0·02434	5·86
0·005413	0·04066	5·86
0·005328	0·05094	5·52
0·009414	0·04943	5·66
0·012830	0·04943	5·87
0·025700	0·04971	5·83

The oxidation reaction, under our conditions, does not induce polymerization of added acrylonitrile indicating the absence of free radicals in the reaction system.

The reaction rate is also dependent on the solvent composition-increasing concentrations of acetic acid sharply decrease the rate of oxidation (Table II).

TABLE II

Effect of solvent composition on the rate of oxidation of mandelic acid by iodosobenzene diacetate

[Mandaleic acid] = 0·02463 M [$C_6H_5I(OAc)_2$] = 0·005207 M Temp. 40° C.

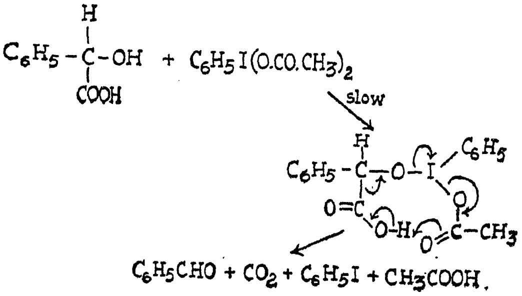
% Acetic acid (v/v)	$k_2 \times 10^3$ litre mole^{-1} sec.$^{-1}$
50	8·51
70	5·86
90	4·38

This observation is quite analogous to lead tetraacetate oxidations[5] wherein addition of water or methanol to an acetic acid solvent increased the rate of oxidation of diols considerably by solvolysing the lead tetraacetate to a more active oxidant like $Pb(OAc)_2(OR)_2$. A similar hydrolysis would yield in the case of iodosobenzene diacetate

$$\mathrm{ArI(O.CO.CH_3)_2 + H_2O \rightleftharpoons ArI(C.CO.CH_3)(OH) + CH_3COOH.}$$

There also exists an inverse relationship between the rate of oxidation and the concentration of acetic acid, in keeping with the above prediction.

On an analogy with the lead tetraacetate oxidations[2] of α-hydroxy acids we propose the following mechanism for the oxidation of mandelic acid by iodosobenzene diacetate,



Dept. of Chemistry, K. VAIDYANATHAN.
Vivekananda College, N. VENKATASUBRAMANIAN.
Mylapore, Madras-4,
December 2, 1969.

---

1. Criegee, R., *Angew. Chem.*, 1958, **70**, 173.
2. Bunton, C. A., *Oxidation in Organic Chemistry*, Edited by Wiberg, K. B., Academic Press, New York, 1965, p. 403.
3. Pausacker, K. H., *J. Chem. Soc.*, 1953, p. 107.
4. Cordner, J. and Pausacker, K. H., *Ibid.*, 1953, p. 102.
5. Buchner, E. and Criegee, R., *Ber.*, 1940, **73**, 563.

SOME NEW 6 : 8-DICHLORO-S-SUBSTITUTED 2-THIO-3-ARYL 4-QUINAZOLONES

SEVERAL 4-quinazolone derivatives and 2- or 4-sulphanilamido-quinazolones have been reported to be therapeutically active against simian and avian malarial infec Recently, Bhargava *et al.*[5-7] have al thesised a large number of S-substituted 4-quinazolones many of which have bee to be sufficiently active against *P. galli* in chicks.

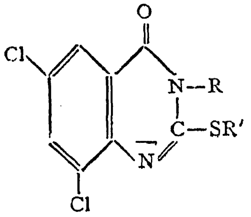
These significant biological activiti ciated with 4-quinazolones inspired th to synthesise some new S-substituted 2- aryl-4-quinazolones as possible antim In the present investigation, the synth 6 : 8-dichloro-S-substituted 2-thio-3- quinazolones from 3 : 5-dichloroant acid, aryl isothiocyanates and alkyl hali been studied as listed in Table I.

6 : 8 - Dichloro - 2 - carboxymethylthio - ethoxyphenyl-4-quinazolone was pr according to the method of Bhargava and The product was crystallised from Yield, 65%, m.p. 222° C. (Found : N, 6· 7·32. $C_{18}H_{14}Cl_2N_2O_4S$ requires N, 6· 7·52%).

Bis - (6 : 8-dichloro - 3 - p - ethoxyp quinazolonyl) -disulphide.—Saturated i solution was added drop by drop alkaline solution of the 6 : 8-dichl mercapto-3-*p*-ethoxyphenyl-4-quinazolon

TABLE I

6 : 8-Dichloro-2-(substituted) thio-3-aryl- 4-quinazolones



Aryl group R		Substituent R′	Yield %	M.P. °C	Molecular formula*	Nitrogen, %	
						Found	[illegible]
o-Tolyl	..	H	75	205	$C_{15}H_{10}Cl_2N_2OS$	8·12	8·[illegible]
m-Tolyl	..	H	70	207	$C_{15}H_{10}Cl_2N_2OS$	7·85	8·[illegible]
p-Methoxyphenyl	..	H	80	188	$C_{15}H_{10}Cl_2N_2O_2S$	7·69	7·[illegible]
p-Ethoxyphenyl	..	H	85	215	$C_{16}H_{12}Cl_2N_2O_2S$	7·28	7·[illegible]
,,	..	Ethyl	60	227	$C_{18}H_{16}Cl_2N_2O_2S$	6·81	7·[illegible]
p-Methoxyphenyl	..	*n*-Butyl	40	234	$C_{19}H_{18}Cl_2N_2O_2S$	6·48	6·[illegible]
p-Ethoxyphenyl	..	,,	44	250	$C_{20}H_{20}Cl_2N_2O_2S$	6·42	6·[illegible]
m-Tolyl	..	*o*-Nitrobenzyl	45	75	$C_{22}H_{15}Cl_2N_3O_2S$	8·72	8·[illegible]
p-Methoxyphenyl	..	,,	50	103	$C_{22}H_{15}Cl_2N_3O_4S$	8·31	8·[illegible]
p-Ethoxyphenyl	..	,,	45	165	$C_{23}H_{17}Cl_2N_3O_4S$	8·14	8·[illegible]
m-Tolyl	..	N, N-Ethylphenyl-carboxamidomethyl	50	68	$C_{25}H_{21}Cl_2N_3O_2S$	8·15	8·[illegible]
p-Methoxyphenyl	..	,,	55	108	$C_{25}H_{21}Cl_2N_3O_3S$	8·31	8·[illegible]
p-Ethoxyphenyl	..	,,	40	89	$C_{26}H_{23}Cl_2N_3O_3S$	7·62	7·[illegible]
m-Tolyl	..	N, N-benzylphenyl-carboxamidomethyl	45	83	$C_{30}H_{23}Cl_2N_3O_2S$	7·18	7·[illegible]
p-Ethoxyphenyl	..	,,	48	104	$C_{31}H_{25}Cl_2N_3O_3S$	7·22	7·1[illegible]

* All compounds were analysed for S also and [illegible]

gave a light brownish amorphous mass which was washed with potassium iodide solution to remove excess of iodine, water and finally with ethanol. The crude product was crystallised from glacial acetic acid into shining colourless needles. Yield, 55%, m.p. 233° C. (Found: N, 7·2; S, 8·45. $C_{32}H_{22}Cl_4N_4O_4S_2$ requires N, 7·65; S, 8·74%).

6 : 8-Dichloro-2-ethylthio-3-*p*-ethoxyphenyl-4-quinazolone was hydrolysed into 6 : 8-dichloro-3-*p*-ethoxyphenylquinazolin-2 : 4-dione with alcoholic 6 N HCl as usual.[5] The hydrolysed product was crystallised from ethanol. Yield, 45%, m.p. 239° C. (Found : N, 7·75; $C_{16}H_{12}Cl_2N_2O_3$ requires N, 7·97%).

Thanks are due to Dr. P. N. Bhargava for guidance and to the U.G.C. for the award of a scholarship.

Department of Chemistry, HARIHAR SINGH.
Banaras Hindu University,
Varanasi-5, *November* 19, 1969.

---

1. Singh, J. and Singh, H., *J. Malarial Inst. India*, 1939, **2**, 181.
2. Marshal, E. K., Litchfield J. T. and While, H. J., *J. Pharmacol.*, 1942, **75**, 89.
3. Wolf, F. I., *U.S. Patent* 2473931, 1949; *C.A.*, 1949, **43**, 7042.
4. Baker, B. R., Mc Evoy, F. J., Schoub, R. E., Joseph, J. P. and Williams, J. H. *J., Org. Chem.*, 1953, **18**, 178.
5. Chaurasia, M. R., *Agri. Biol. Chem.*, 1968, **32**, 711.
6. Bhargava, P. N. and Ram, P., *Bull. Chem. Soc., Japan*, 1965, **38**, 342.
7. — and Lakhan, R., *Ibid.*, 1969, **42**, 1444.

EFFECT OF BORON ON STARCH AND PROTEIN CONTENTS OF WHEAT GRAINS

EVEN when all the micronutrients are present in optimum concentrations in a soil, additional application of boron only is known to enhance the yield of crops.[1] A net increase in the dry weights of developing grains is primarily due to the accumulation of starch and protein in the endosperm. A decline in protein content in mature parts of many plants is often accompanied by an accumulation of amino-acids and some non-protein nitrogen compounds due to boron deficiency.[2] This would be expected if the availability of ATP for protein biosynthesis was to fail owing to lack of carbohydrate supplies. The present investigation was started to understand whether boron had any effect on starch and protein contents of wheat grains and further whether protein content of wheat grains was in any way dependent on their starch content which is a product of translocated glucose from other vegetative parts of the plant.

A field experiment with six treatments (Control; Boron; Nitrogen; Nitrogen + Boron; Nitrogen + Potassium + Phosphorus and Nitrogen + Potassium + Phosphorus + Boron) and three replications for each was undertaken. Fertilizers were used at the rates of superphosphate 375, potash 40, ammonium sulphate 600 and boric acid 20 lb./acre. All the fertilizers (except half of nitrogen) were applied at the time of sowing; the second dose of nitrogen fertilizer was applied about one month after sowing along with the first irrigation.

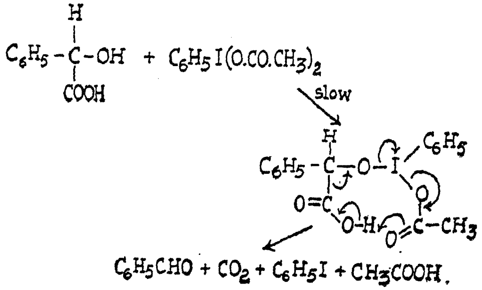
Ripened grains from each bed were randomly collected and pooled for chemical analyses. Starch and protein were estimated by titrimetric[3] and microkjeldahl[4] methods respectively.

TABLE I
Effect of boron on starch and protein contents of wheat grains

Treatment	Percentage starch	Percentage increase	Percentage protein	Percentage increase
Control ..	63·551*	..	17·80	..
B ..	64·010	0·72	18·46	3·71
N ..	64·392	..	16·62	..
N+B ..	69·983	8·78	17·55	5·60
N+K+P ..	67·213	..	18·88	..
N+K+P+B	67·574	0·53	19·85	5·10

* Each value represents a mean of three replications.

Our observations (Table I) showed that whereas the starch contents of grains of boron- and NPKB-treated plants increased by 0·72% and 0·53% only as compared to control and NPK-treated plants respectively, there was a significant increase (8·78%) in starch content of N+B-treated grains as compared to those treated with only nitrogen. N+B treatment might influence starch synthesis either by affecting the equilibrium in phosphoglucomutase reaction,[5] or by activating uridine diphosphoglucose pyrophosphorylase resulting in increased UDPG formation.[6] The exact role of nitrogen along with boron in increasing the starch content of wheat grains needs further investigation. A negligible increase in the percentage of starch in case of NPKB-treated plants is considered to be due to a higher concentration of available inorganic phosphate which shifts the equilibrium of phosphorylase reaction towards starch degradation. The authors are of the opinion that the net influence of boron on starch synthesis is affected by the available nitrogen and phosphorus. A low increase in the percentage of



Dept. of Chemistry, K. VAIDYANATHAN.
Vivekananda College, N. VENKATASUBRAMANIAN.
Mylapore, Madras-4,
December 2, 1969.

---

1. Criegee, R., *Angew. Chem.*, 1958, **70**, 173.
2. Bunton, C. A., *Oxidation in Organic Chemistry*, Edited by Wiberg, K. B., Academic Press, New York, 1965, p. 403.
3. Pausacker, K. H., *J. Chem. Soc.*, 1953, p. 107.
4. Cordner, J. and Pausacker, K. H., *Ibid.*, 1953, p. 102.
5. Buchner, E. and Criegee, R., *Ber.*, 1940, **73**, 563.

SOME NEW 6 : 8-DICHLORO-S-SUBSTITUTED 2-THIO-3-ARYL 4-QUINAZOLONES

SEVERAL 4-quinazolone derivatives and 2- or 4-sulphanilamido-quinazolones have been reported to be therapeutically active against simian and avian malarial infections.[1-4] Recently, Bhargava *et al.*[5-7] have also synthesised a large number of S-substituted 2-thio-4-quinazolones many of which have been found to be sufficiently active against *P. gallinaceum* in chicks.

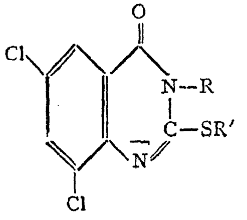
These significant biological activities associated with 4-quinazolones inspired the author to synthesise some new S-substituted 2-thio-3-aryl-4-quinazolones as possible antimalarials. In the present investigation, the synthesis of 6 : 8-dichloro-S-substituted 2-thio-3-aryl-4-quinazolones from 3 : 5-dichloroanthranilic acid, aryl isothiocyanates and alkyl halides has been studied as listed in Table I.

6 : 8 - Dichloro - 2 - carboxymethylthio - 3-*p*-ethoxyphenyl-4-quinazolone was prepared according to the method of Bhargava and Ram.[6] The product was crystallised from ethanol. Yield, 65%, m.p. 222° C. (Found : N, 6·21 ; S, 7·32. $C_{18}H_{14}Cl_2N_2O_4S$ requires N, 6·57 ; S, 7·52%).

Bis - (6 : 8-dichloro - 3 - p - ethoxypenyl-4-quinazolonyl)-disulphide.—Saturated iodine solution was added drop by drop to an alkaline solution of the 6 : 8-dichloro-2-mercapto-3-*p*-ethoxyphenyl-4-quinazolone. It

TABLE I

6 : 8-Dichloro-2-(substituted) thio-3-aryl-4-quinazolones



Aryl group R		Substituent R′	Yield %	M.P. °C	Molecular formula*	Nitrogen, % Found	Nitrogen, % Calcd.
o-Tolyl	..	H	75	205	$C_{15}H_{10}Cl_2N_2OS$	8·12	8·31
m-Tolyl	..	H	70	207	$C_{15}H_{10}Cl_2N_2OS$	7·85	8·31
p-Methoxyphenyl	..	H	80	188	$C_{15}H_{10}Cl_2N_2O_2S$	7·69	7·93
p-Ethoxyphenyl	..	H	85	215	$C_{16}H_{12}Cl_2N_2O_2S$	7·28	7·62
,,	..	Ethyl	60	227	$C_{18}H_{16}Cl_2N_2O_2S$	6·81	7·09
p-Methoxyphenyl	..	*n*-Butyl	40	234	$C_{19}H_{18}Cl_2N_2O_2S$	6·48	6·84
p-Ethoxyphenyl	..	,,	44	250	$C_{20}H_{20}Cl_2N_2O_2S$	6·42	6·62
m-Tolyl	..	*o*-Nitrobenzyl	45	75	$C_{22}H_{15}Cl_2N_3O_2S$	8·72	8·89
p-Methoxyphenyl	..	,,	50	103	$C_{22}H_{15}Cl_2N_3O_4S$	8·31	8·60
p-Ethoxyphenyl	..	,,	45	165	$C_{23}H_{17}Cl_2N_3O_4S$	8·14	8·36
m-Tolyl	..	N, N-Ethylphenyl-carboxamidomethyl	50	68	$C_{25}H_{21}Cl_2N_3O_2S$	8·15	8·43
p-Methoxyphenyl	..	,,	55	108	$C_{25}H_{21}Cl_2N_3O_3S$	8·31	8·17
p-Ethoxyphenyl	..	,,	40	89	$C_{26}H_{23}Cl_2N_3O_3S$	7·62	7·95
m-Tolyl	..	N, N-benzylphenyl-carboxamidomethyl	45	83	$C_{30}H_{23}Cl_2N_3O_2S$	7·18	7·49
p-Ethoxyphenyl	..	,,	48	104	$C_{31}H_{25}Cl_2N_3O_3S$	7·22	7·11

* All compounds were analysed for S also and found to give satis

gave a light brownish amorphous mass which was washed with potassium iodide solution to remove excess of iodine, water and finally with ethanol. The crude product was crystallised from glacial acetic acid into shining colourless needles. Yield, 55%, m.p. 233° C. (Found: N, 7·2; S, 8·45. $C_{32}H_{22}Cl_4N_4O_4S_2$ requires N, 7·65; S, 8·74%).

6 : 8-Dichloro-2-ethylthio-3-p-ethoxyphenyl-4-quinazolone was hydrolysed into 6 : 8-dichloro-3-p-ethoxyphenylquinazolin-2 : 4-dione with alcoholic 6 N HCl as usual.[5] The hydrolysed product was crystallised from ethanol. Yield, 45%, m.p. 239° C. (Found : N, 7·75; $C_{16}H_{12}Cl_2N_2O_3$ requires N, 7·97%).

Thanks are due to Dr. P. N. Bhargava for guidance and to the U.G.C. for the award of a scholarship.

Department of Chemistry, HARIHAR SINGH.
Banaras Hindu University,
Varanasi-5, *November* 19, 1969.

---

1. Singh, J. and Singh, H., *J. Malarial Inst. India*, 1939, **2**, **181**.
2. Marshal, E. K., Litchfield J. T. and While, H. J., *J. Pharmacol.*, 1942, **75**, 89.
3. Wolf, F. I., *U.S. Patent* 2473931, 1949; *C.A.*, 1949, **43**, 7042.
4. Baker, B. R., Mc Evoy, F. J., Schoub, R. E., Joseph, J. P. and Williams, J. H. *J., Org. Chem.*, 1953, **18**, 178.
5. Chaurasia, M. R., *Agri. Biol. Chem.*, 1968, **32**, 711.
6. Bhargava, P. N. and Ram, P., *Bull. Chem. Soc., Japan*, 1965, **38**, 342.
7. — and Lakhan, R., *Ibid.*, 1969, **42**, 1444.

EFFECT OF BORON ON STARCH AND PROTEIN CONTENTS OF WHEAT GRAINS

EVEN when all the micronutrients are present in optimum concentrations in a soil, additional application of boron only is known to enhance the yield of crops.[1] A net increase in the dry weights of developing grains is primarily due to the accumulation of starch and protein in the endosperm. A decline in protein content in mature parts of many plants is often accompanied by an accumulation of amino-acids and some non-protein nitrogen compounds due to boron deficiency.[2] This would be expected if the availability of ATP for protein biosynthesis was to fail owing to lack of carbohydrate supplies. The present investigation was started to understand whether boron had any effect on starch and protein contents of wheat grains and further whether protein content of wheat grains was in any way dependent on their starch content which is a product of translocated glucose from other vegetative parts of the plant.

A field experiment with six treatments (Control; Boron; Nitrogen; Nitrogen + Boron; Nitrogen + Potassium + Phosphorus and Nitrogen + Potassium + Phosphorus + Boron) and three replications for each was undertaken. Fertilizers were used at the rates of superphosphate 375, potash 40, ammonium sulphate 600 and boric acid 20 lb./acre. All the fertilizers (except half of nitrogen) were applied at the time of sowing; the second dose of nitrogen fertilizer was applied about one month after sowing along with the first irrigation.

Ripened grains from each bed were randomly collected and pooled for chemical analyses. Starch and protein were estimated by titrimetric[3] and microkjeldahl[4] methods respectively.

Our observations (Table I) showed that whereas the starch contents of grains of boron- and NPKB-treated plants increased by 0·72% and 0·53% only as compared to control and NPK-treated plants respectively, there was a significant increase (8·78%) in starch content of N+B-treated grains as compared to those treated with only nitrogen. N+B treatment might influence starch synthesis either by affecting the equilibrium in phosphoglucomutase reaction,[5] or by activating uridine diphosphoglucose pyrophosphorylase resulting in increased UDPG formation.[6] The exact role of nitrogen along with boron in increasing the starch content of wheat grains needs further investigation. A negligible increase in the percentage of starch in case of NPKB-treated plants is considered to be due to a higher concentration of available inorganic phosphate which shifts the equilibrium of phosphorylase reaction towards starch degradation. The authors are of the opinion that the net influence of boron on starch synthesis is affected by the available nitrogen and phosphorus. A low increase in the percentage of

TABLE I

Effect of boron on starch and protein contents of wheat grains

Treatment	Percentage starch	Percentage increase	Percentage protein	Percentage increase
Control ..	63·551*	..	17·80	..
B ..	64·010	0·72	18·46	3·71
N ..	64·392	..	16·62	..
N+B ..	69·983	8·78	17·55	5·60
N+K+P ..	67·213	..	18·88	..
N+K+P+B	67·574	0·53	19·85	5·10

* Each value represents a mean of three replications.

starch in case of grains obtained from plants treated with only boron showed that the application of boron alone might not be responsible for increasing the dry weight of grains due to starch accumulation.

Boron treatments increase the percentage protein contents of wheat grains as compared to correspondingly treated plants without any boron application. Maximum increase in protein (5·6%) content was observed again in the case of N+B-treated grains, and there was almost an equal (5·1%) increase in case of NPKB-treated plants. Protein synthesis, therefore, does not seem to be affected on account of the lack of glucose supply which would affect the concentration of available ATP. Boron thus seems to have a control on protein biosynthesis independent of its translocating effect on glucose.

Dept. of Biochemistry, H. M. DANI.
Panjab University, H. S. SAINI.
Chandigarh (India), S. S. SAINI.
October 28, 1969. K. SAREEN.

---

1. Dani, H. M., *M.Sc. Thesis*, *I.A.R.I.*, New Delhi, 1961.
2. Steward, F. C., *Plant Physiology* (A Treatise), 1963, **3**, 261.
3. A.O.A.C., 1965.
4. *Ibid.*
5. Steward, F. C., *Plant Physiology* (A Treatise), 1963, **3**, 266.
6. Dugger, W. M., Jr. and Humphries, T. E., *Plant Physiol.*, 1960, **35**, 523.

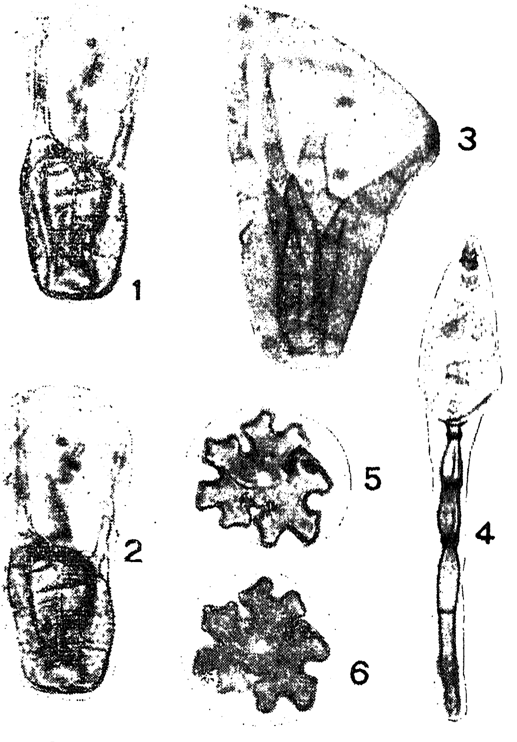
FUNGAL REMAINS FROM BENGAL PEAT

THE sub-fossil fungal records from the Pleistocene deposits of India are very meagre. The peat/clay samples were collected from the exposed pit for pollen-analytical investigations at Sankrail, Rajganj, situated about 10 km. away from Indian Botanic Gardens, Sibpur, Howrah (22° 35′ long. and 80° 20′ lat.). The samples have been analysed for palynological investigations. The occurrence of fungal remains is scanty or even nil upto 70 cm. but at 80 cm., a good assemblage of fungal remains has been encountered below which the occurrence further dwindles. At present only the identifiable specimens have been reported. All the three fungi are saprophytic in nature. *Tetraploa aristata* Berk. and Br. is reported to occur on the decaying stems of *Andropogon sorghum* Brot. and *Triticum vulgare* Vill. from Patna, Bihar (Lal and Yadav, 1965). Krik (1969) has reported the occurrence of *Tetraploa aristata* Berk. & Br. both from marine and freshwater streams. According to Sreeramulu and Ramalingam (1962) *Tetraploa aristata* Berk & Br. is more common in India than *T. ellisii* Cooke. Agnihothrudu (1962) collected *Anellophora mussændæ* Ellis from the decaying tea prunings at Tocklai, Assam.

Tetraploa BERR. & BR.

The genus is known by the spores only. The colonies are either absent or destroyed during the process of acetolysis. The spores are quadri-articulate and oblong in shape. They are aristate on the top and are provided with septate setæ. They are typically dictyosporous and quadriseriate and may be regarded as made up of four spores or spores formed by four parallel rows of cells, each cell being terminated by a stiff seta. The setæ are generally four in number, broader at the base and narrower at the apex.

The spores are 38–45 μ long and setæ 30–35 μ long. On the basis of size and general shape, the spores have been identified as belonging to two different species, *i.e.*, spores smaller and compact—*T. aristata* Berk. & Br. (Figs. 1–2); spores larger and loose—*T. ellisii* Cooke (Fig. 3).



FIGS. 1–6. Figs. 1–2. *Tetraploa aristata*, × 500. Fig. 3. *Tetraploa ellisii*, × 500. Fig. 4. *Anellophora mussændæ*, × 500. Figs. 5–6. *Entophlyctis lobata*, × 500.

Anellophora mussændæ M. B. ELLIS (FIG. 4)

The specimen is represented by conidia and conidiophores. The conidiophores are straight, flexuous, septate with a somewhat bulbous base. The conidiophores measure 80 μ in length and 7 μ in diameter at its wider part. The conidia are more or less straight and fusiform in shape measuring 44 μ long and 18 μ in diameter at the widest part.

SAPROPHYTIC CHYTRIDS (FIGS. 5-6)

The specimen is represented by sporangia which are deeply lobed and their margins are very much thickened. In the centre of the sporangia one prominent pore is present which may be an opening for the spores to come out from the sporangium. The specimen is comparable with the *Entophlyctis lobata* (Willoughby and Townby, 1961).

I sincerely thank Dr. J. P. Tewari of Botany Department, Lucknow University, for helpful suggestions.

Birbal Sahni Institute of Palæobotany,
Lucknow, *December* 10, 1969.
H. P. GUPTA.

---

1. Agnihothrudu, V., *Jour. Ind. Bot. Soc.*, **41**, 465, 478
2. Krik, P. W. Jr., *Mycologia*, 1969, **61**, 177.
3. Lal, S. P. and Yadav, A. S., *Jour. Ind. Bot. Soc.*, 1965, **44** (3), 402.
4. Sreeramulu, T. and Ramalingam, A., *Curr. Sci.*, 1962, **31**, 121.
5. Willoughby, L. G. and Townby, J. P., *Trans. Brit. Mycol. Soc.*, 1961, **44** (2), 177.

EXPERIMENTAL DEVELOPMENT OF THE OESOPHAGEAL WORM OF CATTLE IN RABBIT

BESIDES cattle, buffalo, sheep, goat, horse, donkey, pig and camel, *Gongylonema pulchrum* occurs in the mucosa of mouth, œsophagus and tongue in several other mammals : deer, chevrotain, monkey and occasionally man.[2,8] It has also been recorded in the rumen of herbivores.[2] Numerous species of dung beetles belonging to a large number of genera under Scarabæidæ, Tenebrionidae, Hydrophilidæ and Histeridæ are known to act as its intermediate hosts. *Blatella germanica* too has been reported to carry its larval form.

Infection experiments with rabbit, guinea-pig, white albino rat, white mouse, dog, pig, sheep and chicken have been carried out by a number of workers who have, however, reported varying findings.[1,4-7]

The cyst and the infective larva of *G. pulchrum*, from *Onthophagus deflexicollis* Lansb., *O. catta* (F.), *O. quadridentatus* (F.) and *Oniticellus pallens* Oliv., have been described in an earlier communication.[3] During our studies on the diverse spiruroid larval forms infesting the common coprophagous beetles, an identical larva was recovered from three additional species : *Aphodius mœstus* (F.), *Catharsius* sp. and *Onthophagus* sp. and three others awaiting specific determination. The larvæ were fed to three rabbits—26 to one, 12 to second and 9 to third, to study the course of development. The infected rabbits were slaughtered on 35th, 50th and 84th day of infection.

The first rabbit yielded two males which, with 13·136–14·404 mm. in length and 0·154–0·157 mm. in maximum thickness, had asymmetrical caudal alæ with the left extending further forward than the right and continued posteriorly round the tip of tail ; 0·191–0·202 mm. long tail ; five pairs of asymmetrical preanal papillæ with long peduncles and pedunculated post-anals consisting of 5 papillæ on the right and 4 on the left side (the group of four pairs of very small sessile papillæ near the tip of the tail, described by Baylis,[2] not discernible) ; the long and slender left spicule of 3·532–3·680 mm. and with a narrow tubular shaft ; the stouter and broadly alate right spicule of 0·116–0·118 mm. ; and the gubernaculum of 0·070–0·072 mm. in length.

The second rabbit had 8 sinuous galleries. 2 males and 3 females were extracted from 5 tunnels. The males, 20·058–29·954 mm. in length and 0·157–0·232 mm. in maximum thickness, exhibited the characteristic pattern of the caudal end observed in the 35-day specimens with the left spicule of 3·258–5·303 mm., the right of 0·113–0·125 mm. and the gubernaculum of 0·071–0·083 mm. length. The females, 49·897–50·881 mm. in length and 0·236–0·239 mm. in maximum thickness, had the vulva at 3·411–4·236 mm. distance in front of the posterior end and a 3·720–3·911 mm. long vagina.

The third rabbit yielded a male and a female specimen. The male, 14·623 mm. in length and 0·154 mm. in maximum thickness, had the characteristics of the caudal end described in the 35-day specimens with the left spicule of 3·720 mm., the right of 0·116 mm. and the gubernaculum of 0·075 mm. length. The female, 38·341 mm. in length and 0·222 mm. in maximum thickness, revealed the prominent vulva at 2·147 mm. distance in front of the posterior end and a 3·829 mm. long vagina.

starch in case of grains obtained from plants treated with only boron showed that the application of boron alone might not be responsible for increasing the dry weight of grains due to starch accumulation.

Boron treatments increase the percentage protein contents of wheat grains as compared to correspondingly treated plants without any boron application. Maximum increase in protein (5·6%) content was observed again in the case of N+B-treated grains, and there was almost an equal (5·1%) increase in case of NPKB-treated plants. Protein synthesis, therefore, does not seem to be affected on account of the lack of glucose supply which would affect the concentration of available ATP. Boron thus seems to have a control on protein biosynthesis independent of its translocating effect on glucose.

Dept. of Biochemistry, H. M. DANI.
Panjab University, H. S. SAINI.
Chandigarh (India), S. S. SAINI.
October 28, 1969. K. SAREEN.

---

1. Dani, H. M., *M.Sc. Thesis*, *I.A.R.I.*, New Delhi, 1961.
2. Steward, F. C., *Plant Physiology* (A Treatise), 1963, **3**, 261.
3. A.O.A.C., 1965.
4. *Ibid.*
5. Steward, F. C., *Plant Physiology* (A Treatise), 1963, **3**, 266.
6. Dugger, W. M., Jr. and Humphries, T. E., *Plant Physiol.*, 1960, **35**, 523.

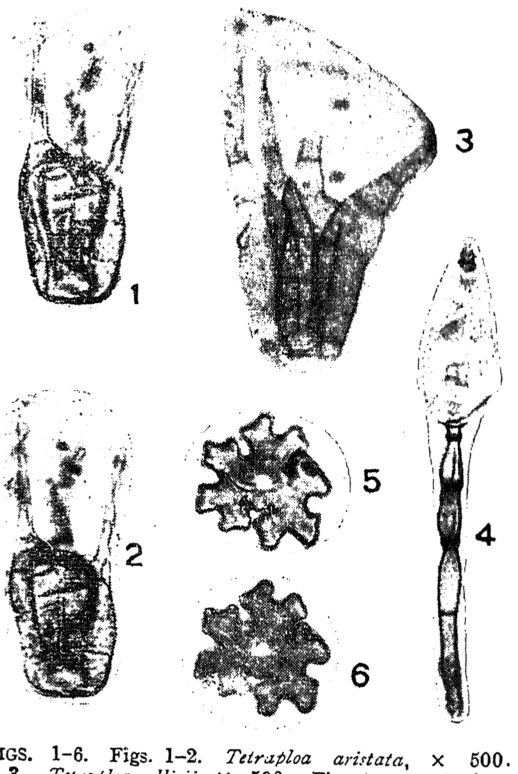
FUNGAL REMAINS FROM BENGAL PEAT

THE sub-fossil fungal records from the Pleistocene deposits of India are very meagre. The peat/clay samples were collected from the exposed pit for pollen-analytical investigations at Sankrail, Rajganj, situated about 10 km. away from Indian Botanic Gardens, Sibpur, Howrah (22° 35′ long. and 80° 20′ lat.). The samples have been analysed for palynological investigations. The occurrence of fungal remains is scanty or even nil upto 70 cm. but at 80 cm., a good assemblage of fungal remains has been encountered below which the occurrence further dwindles. At present only the identifiable specimens have been reported. All the three fungi are saprophytic in nature. *Tetraploa aristata* Berk. and Br. is reported to occur on the decaying stems of *Andropogon sorghum* Brot. and *Triticum vulgare* Vill. from Patna, Bihar (Lal and Yadav, 1965). Krik (1969) has reported the occurrence of *Tetraploa aristata* Berk. & Br. both from marine and freshwater streams. According to Sreeramulu and Ramalingam (1962) *Tetraploa aristata* Berk & Br. is more common in India than *T. ellisii* Cooke. Agnihothrudu (1962) collected *Anellophora mussœndœ* Ellis from the decaying tea prunings at Tocklai, Assam.

Tetraploa BERR. & BR.

The genus is known by the spores only. The colonies are either absent or destroyed during the process of acetolysis. The spores are quadri-articulate and oblong in shape. They are aristate on the top and are provided with septate setæ. They are typically dictyosporous and quadriseriate and may be regarded as made up of four spores or spores formed by four parallel rows of cells, each cell being terminated by a stiff seta. The setæ are generally four in number, broader at the base and narrower at the apex.

The spores are 38–45 μ long and setæ 30–35 μ long. On the basis of size and general shape, the spores have been identified as belonging to two different species, *i.e.*, spores smaller and compact—*T. aristata* Berk. & Br. (Figs. 1-2); spores larger and loose—*T. ellisii* Cooke (Fig. 3).



FIGS. 1-6. Figs. 1-2. *Tetraploa aristata*, × 500. Fig. 3. *Tetraploa ellisii*, × 500. Fig. 4. *Anellophora mussœndœ*, × 500. Figs. 5-6. *Entophlyctis lobata*, × 500.

Anellophora mussændæ M. B. Ellis (Fig. 4)

The specimen is represented by conidia and conidiophores. The conidiophores are straight, flexuous, septate with a somewhat bulbous base. The conidiophores measure 80 μ in length and 7 μ in diameter at its wider part. The conidia are more or less straight and fusiform in shape measuring 44 μ long and 18 μ in diameter at the widest part.

Saprophytic Chytrids (Figs. 5-6)

The specimen is represented by sporangia which are deeply lobed and their margins are very much thickened. In the centre of the sporangia one prominent pore is present which may be an opening for the spores to come out from the sporangium. The specimen is comparable with the *Entophlyctis lobata* (Willoughby and Townby, 1961).

I sincerely thank Dr. J. P. Tewari of Botany Department, Lucknow University, for helpful suggestions.

Birbal Sahni Institute of Palæobotany,
Lucknow, *December* 10, 1969.

H. P. Gupta.

---

1. Agnihothrudu, V., *Jour. Ind. Bot. Soc.*, **41**, 465, 478
2. Krik, P. W. Jr., *Mycologia*, 1969, **61**, 177.
3. Lal S. P. and Yadav, A. S., *Jour. Ind. Bot. Soc.*, 1965, **44** (3), 402.
4. Sreeramulu, T. and Ramalingam, A., *Curr. Sci.*, 1962, **31**, 121.
5. Willoughby, L. G. and Townby, J. P., *Trans. Brit. Mycol. Soc.*, 1961, **44** (2), 177.

EXPERIMENTAL DEVELOPMENT OF THE OESOPHAGEAL WORM OF CATTLE IN RABBIT

Besides cattle, buffalo, sheep, goat, horse, donkey, pig and camel, *Gongylonema pulchrum* occurs in the mucosa of mouth, œsophagus and tongue in several other mammals : deer, chevrotain, monkey and occasionally man.[2,8] It has also been recorded in the rumen of herbivores.[2] Numerous species of dung beetles belonging to a large number of genera under Scarabæidæ, Tenebrionidae, Hydrophilidæ and Histeridæ are known to act as its intermediate hosts. *Blatella germanica* too has been reported to carry its larval form.

Infection experiments with rabbit, guinea-pig, white albino rat, white mouse, dog, pig, sheep and chicken have been carried out by a number of workers who have, however, reported varying findings.[1,4-7]

The cyst and the infective larva of *G. pulchrum*, from *Onthophagus deflexicollis* Lansb., *O. catta* (F.), *O. quadridentatus* (F.) and *Oniticellus pallens* Oliv., have been described in an earlier communication.[3] During our studies on the diverse spiruroid larval forms infesting the common coprophagous beetles, an identical larva was recovered from three additional species : *Aphodius mœstus* (F.), *Catharsius* sp. and *Onthophagus* sp. and three others awaiting specific determination. The larvæ were fed to three rabbits—26 to one, 12 to second and 9 to third, to study the course of development. The infected rabbits were slaughtered on 35th, 50th and 84th day of infection.

The first rabbit yielded two males which, with 13·136–14·404 mm. in length and 0·154–0·157 mm. in maximum thickness, had asymmetrical caudal alæ with the left extending further forward than the right and continued posteriorly round the tip of tail; 0·191–0·202 mm. long tail; five pairs of asymmetrical preanal papillæ with long peduncles and pedunculated post-anals consisting of 5 papillæ on the right and 4 on the left side (the group of four pairs of very small sessile papillæ near the tip of the tail, described by Baylis,[2] not discernible); the long and slender left spicule of 3·532–3·680 mm. and with a narrow tubular shaft; the stouter and broadly alate right spicule of 0·116–0·118 mm.; and the gubernaculum of 0·070–0·072 mm. in length.

The second rabbit had 8 sinuous galleries. 2 males and 3 females were extracted from 5 tunnels. The males, 20·058–29·954 mm. in length and 0·157–0·232 mm. in maximum thickness, exhibited the characteristic pattern of the caudal end observed in the 35-day specimens with the left spicule of 3·258–5·303 mm., the right of 0·113–0·125 mm. and the gubernaculum of 0·071–0·083 mm. length. The females, 49·897–50·881 mm. in length and 0·236–0·239 mm. in maximum thickness, had the vulva at 3·411–4·236 mm. distance in front of the posterior end and a 3·720–3·911 mm. long vagina.

The third rabbit yielded a male and a female specimen. The male, 14·623 mm. in length and 0·154 mm. in maximum thickness, had the characteristics of the caudal end described in the 35-day specimens with the left spicule of 3·720 mm., the right of 0·116 mm. and the gubernaculum of 0·075 mm. length. The female, 38·341 mm. in length and 0·222 mm. in maximum thickness, revealed the prominent vulva at 2·147 mm. distance in front of the posterior end and a 3·829 mm. long vagina, The typical eggs, recovered from the rectal contents, measured 52–56 μ × 33–37 μ and those inside the vagina were of 51–54 μ × 31–35 μ in size.

After infecting seven rabbits with 25–52 larvæ from a large number of beetles belonging to 14 genera, Popova[5] obtained the adults in 78–85 days after infection. In the subsequent infection experiment[6] with 60 rabbits, the time taken for the third and fourth moults was reported as 11th and 36th day and the prepatent period found to be 56th day. In the present feeding experiment, the 35-day old male specimens were preadults; the 50-day old males fully mature while the females, though fully developed, did not contain embryonated eggs. Evidently, full development requires more than 50 days. The adult specimens of the two sexes collected from the 84th day infected rabbit exhibited the size range, the specific characters of the internal structures, including the pedunculated caudal papillæ in male, well within the ranges given by Baylis[2] for *G. pulchrum.*

The present study has demonstrated the successful development of the infective larvæ of *G. pulchrum,* from 10 different species of dung beetles, to the adult stage in experimental rabbits. The observations are in general accord with those of Popova.[6]

Grateful acknowledgement is due to Dr. B. P. Pande, Professor of Parasitology, for his constant supervision and going through the manuscript and to the Indian Council of Agricultural Research for the award of Senior Research Fellowship.

Department of Parasitology, V. P. GUPTA.
U.P. College of Veterinary
Science and Animal Husbandry,
Mathura (U.P.), *July* 9, 1969.

---

1. Alicata, J. E., *Proc. Helminth. Soc. Wash.*, 1934, **1**, 51.
2. Baylis, H. A., *The Fauna of British India including Ceylon and Burma. Nematoda*, Vol. II, Taylor and Francis, London, 1939, p. 274.
3. Chowdhury, N. and Pande, B. P., *Indian J. Anim. Hlth.*, 1968, **7**, 163.
4. Lucker, J. T., *J. Parasit.*, 1932, **19**, 134.
5. Popova, Z. G., *Nauch. Trudy Ukrainsk. Inst, Eksper. Vet.*, 1959, **25**, 19.
6. —, *Ibid.*, 1960, **27**, 28.
7. Tiifnov, T., *Izvstiya na Veterinarniya Institut za Zarazni i Parazitni Bolesti. Sofia*, **7**, 191.
8. Yamaguti, S., *Systema Helminthum*, Vol. III: *The Nematodes of Vertebrates*, Parts I and II. Interscience Publishers, New York and London, 1961, p. 1261.

ON A NEW SPECIES OF *SCHIZOPORELLA* HINCKS (ECTOPROCTA) FROM THE ARABIAN SEA

DURING a study of the fouling bryozoans of the Indian waters 22 species were collected from test panels immersed at various sites in the Cochin Harbour. Among these a new species of the genus *Schizoporella* Hincks was found to occur abundantly during the period, February to May, in this area. A note on this species *Schizoporella cochinensis* sp. nov., named after the type locality Cochin, forms the matter for this communication. The members of the genus *Schizoporella* are characterised by a frontal tremocyst, semicircular aperture with a slight vibracular arch, a rounded sinus at the proximal border of the aperture, well chitinised operculum, lateral avicularia and hyperstomial ovicells.

Diagnosis.—Zoaria encrusting. Colonies form nearly circular regular patches of unilaminar or multilaminar encrustations. Zooecia arranged in longitudinal rows separated by distinct calcareous lines. Front a tremocyst with moderately sized tremopores. An umbo often present. Aperture rounded with a broad proximal sinus (Fig. 1, *a*). Thin and smooth peristome. The operculum with a main marginal sclerite (Fig. 1, *b*). Avicularia present, placed lateral to the orifice, usually inclined inwards. Mandibles triangular or with a rounded tip. Avicularia not present in many zooecia. Ovicells hyperstomial with large

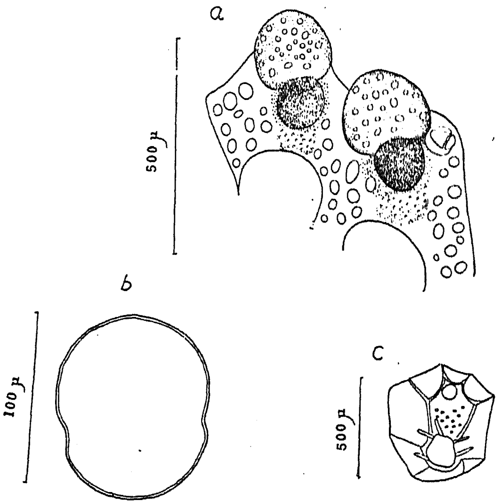


FIG. 1. *Schizoporella cochinensis* sp. nov. (*a*) Two zooecia. (*b*) Operculum. (*c*) Ancestrula.

pores. Embryos light-red in colour. Ancestrula with five very small spines (Fig. 1, c). Length of zooecium 395 μ and breadth 220 to 255 μ.

Morphological Notes.—Numerous colonies of this species were examined and it was noticed that except some variation in the occurrence and number of avicularia in all other characters there was a fair degree of constancy.

Secondary calcification may obscure many of the zooecial characters and the zooecia may assume the shape of calcareous swellings with marginal pores. Umbonate processes are noticed even in young zooecia. In older colonies the ancestrulæ do not possess the spines which evidently are lost as the colony attains age.

Ecological Notes.—*S. cohinensis* breeds during February and March. Maximum settlement of larvæ occurred during these two months. This typically marine and stenohaline species failed to settle on substrata where silting was considerable. Although distributed at all levels within the harbour area, this species settled maximum at sub-tidal level. Experiments on growth showed that this species attains very large size (964 sq. mm. in 45 days) and the colonies attain sexual maturity within 21 days after settlement. This species possesses lecithotrophic larvæ and these larvæ did not settle at the upper reaches of the estuary.

Indian Ocean   N. RAVINDRANATHA MENON.
Biological Centre,
National Institute of Oceanography,
Cochin-18 (India),
and
The Marine Biol. Lab.,   N. BALAKRISHNAN NAIR.
University of Kerala,
Trivandrum-7 (India), *October* 27, 1969.

EMBRYONAL HAUSTORIUM OF *CYCAS CIRCINALIS* L.

WHILE examining the micro-preparations for selecting the post-fertilization stages in *Cycas circinalis* L., the author came across a preparation showing an archegonium with peculiar outgrowth. The archegonium is an old one, having already developed an embryo with a long and tortuous suspensor, pushing the embryo down the archegonium into the endosperm. At this stage the archegonial cavity comes to be filled up with large cells with poor contents having connection with the suspensor at their lower end. At the upper end, this tissue sends out through the neck of the archegonium, a bundle of elongated cells with contents and pominent nuclei. These elongated cells break through the archegonial jacket at its thinner spot which is adjacent to the neck of the archegonium and come to lie in the archegonial chamber spread out in a fan-wise manner. Such a growth appears to be rather rare and requires thorough investigation (Figs. 1-2).

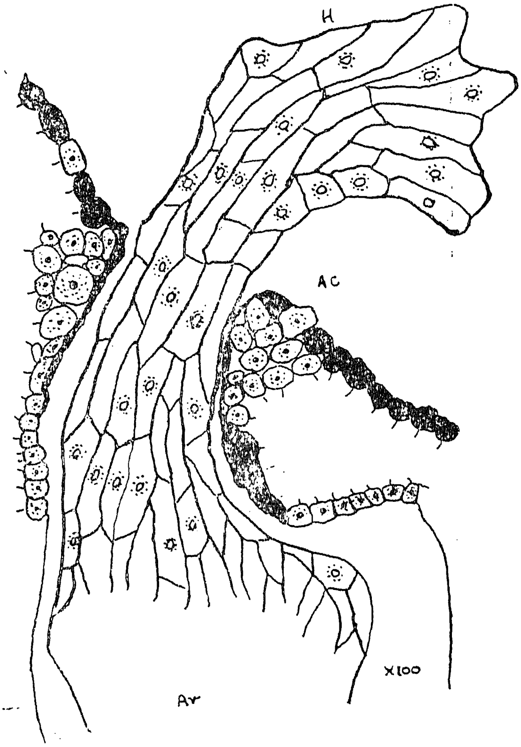


FIG. 1. H = Haustorial growth; Ac = Archegonial chamber; END = Endosperm; Ar = Archegonial cavity.

The large cells in the archegonial cavity no doubt form part of the proembryo and they send out the bundle of cells at their upper end. Hence the morphology of these cells is clear and they belong to the $2x$ generation. Their entry into the archegonial chamber which appears to be empty at this stage of development of the *Cycas* ovule and their function appear to be baffling. One possibility is that this bundle of long cells may act as haustorial cells of the proembryo and try to acquire nutrition from the tissue it comes in contact with. It is well known that the floor of the archegonial chamber is paved with resistant cells and Tannin cells, except the necks of the archegonia. Even the neck region, at this stage is occluded and does not afford any soft landing. The roof of the archegonial chamber is formed by the dried up and papery tissue of the nucellar beak offering very little or no nutritive material. Hence the fan-wise spread out cells ultimately dry up inside the archegonial chamber.

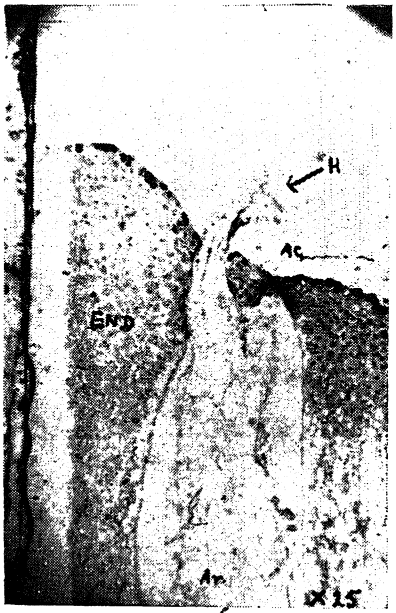


FIG. 2. (For explanation *see* Fig. 1.)

The very fact that cells at the upper end of the archegonium are elongated and grow out of the archegonial cavity shows that there is not enough nutritive material supplied to them from the surrounding endosperm as it is done to the growing suspensor and the embryo proper. At the lower end, the suspensor and the embryo digest the cells studded with starch by aggressive activity and push themselves deeper into the endosperm. Such destarched clear region seen surrounding the embryo and suspensor is not found at the upper region of the archegonium. It is clear, therefore, that the growth of these cells constitutes a case of haustorium of the proembryo which having failed in coming in contact with a rich source of food supply, grow for some time and perish ultimately.

Proliferations of the embryo or its parts inside the female gametophyte are common among gymnosperms; but such a growth outside the endosperm is not known among the gymnosperms though it is common among the angiosperms.

'Jaya Nivas', L. N. RAO.
Gavipuram Extension,
Bangalore-19, *January* 27, 1970.

QUALITATIVE CHANGES IN THE AMINO-ACID CONTENTS OF HYPERTROPHIED ORGANS IN MUSTARD DUE TO *ALBUGO CANDIDA*

Albugo candida (Lev.) Kunze. the fungus that causes white rust of mustard, has been found to be a serious disease of this crop in Haryana and Punjab, if the atmosphere is humid during the flowering season. This pathogen is a big hazard to the crop as in the infected plant the seed-setting is completely or partially hampered. The present study is concerned with the qualitative changes of amino-acids in peduncle, floral buds and mature flowers of mustard under the influence of *A. candida* which induces hypertrophied growth.

For the analysis of amino-acids the alcoholic extracts of healthy and abnormal plant organs were prepared. The qualitative analysis was carried out by two-dimensional descending chromatographic technique on Whatman filter-paper No. 1, using conventional methods. The solvent system used for the development was *n*-butanol-water-acetic acid (4 : 1 : 5) in the first direction and phenol (distilled)-water (4 : 1) in the second direction. The duration of development was 16–19 hours. The dried chromatograms were sprayed with 0·5% acetone to give colour visibility to the amino-acid spots which were then identified by calculating the R_f values and comparing the same with chromatograms run simultaneously. The results are represented in Table I.

TABLE I

Sl. No.	Amino-acid	Peduncle		Buds		Flower	
		Normal	Infected	Normal	Infected	Normal	Infected
1	Arginine ..	+	+	−	+	−	−
2	Asparagine ..	−	−	−	−	+	−
3	B-alanine ..	−	−	−	+	−	+
4	Citrilline ..	−	−	−	+	−	+
5	Cystine ..	−	+	−	+	+	+
6	D-L-aspartic acid ..	−	−	−	−	+	+
7	Glutamic acid ..	−	−	−	+	−	−
8	Glutamine ..	−	−	−	+	+	−
9	Glycine ..	+	−	−	−	−	−
10	Histidine ..	−	+	−	−	−	+
11	Leucine ..	−	−	−	−	−	+
12	Phenyl alanine ..	−	−	−	−	−	+
13	Proline ..	−	+	+	+	+	−
14	γ-Aminobutyric acid	+	−	−	−	−	−
15	Serine ..	−	+	+	−	+	−
16	Threonine ..	+	−	+	−	+	−
17	Tryptophan ..	−	+	−	−	+	−
18	Tyrosine ..	+	+	+	−	+	+
19	Valine	+	+	+	−	+	+

The present study suggests that the amino-acid contents are greatly changed in plant organs under the influence of pathogen due to the changed metabolism of infected host. It is evident from the present investigation that arginine in the peduncle, proline in the bud and cystine, D-L aspartic acid, tyrosine, proline and valine from the flowers are unaffected due to the infection and do not enter into the metabolic pathway (Table I). It has been suggested that the infection causes the breakdown of plant proteins releasing small quantity of tryptophan which reacts with endogenic phenolic acid to produce IAA, which is responsible for hypertrophied growth.[1] Production of tryptophan in the hypertrophied peduncle and the disappearance of tryptophan from normal flower when excited to hypertrophied growth perhaps adduce additional support to this concept. It is possible that in the former the tryptophan is formed during hypertrophied growth and utilized for synthesis of IAA and in the latter tryptophan already present is utilized for synthesis of IAA which induces exaggerated growth. The absence of tryptophan both in normal as well as abnormal flower-bud suggests that the mechanism of hypertrophied growth may be different in this organ (Table I).

Dept. of Botany and Plant Pathology,
Haryana Agric. University,
Hissar (Haryana), *November* 21, 1969.

KAMLESH KUMARI (MISS).
T. M. VARGHESE.
D. SURYANARAYANA.

---

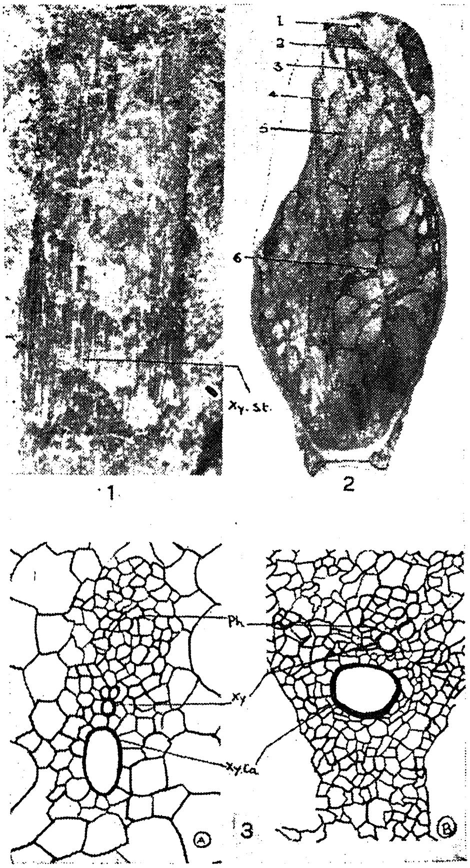
1. Akai, S., *Memo. Coll. Agr. Tokyo Univ.*, 1952, 58, 1.

OCCURRENCE OF A FOSSIL AXIS (NYMPHAECEAE) FROM THE DECCAN INTERTRAPPEAN SERIES OF MOHGAON-KALAN, M.P., INDIA

THE petrified fossil axis described here was collected by the first two authors in December, 1967 from Mohgaon-Kalan (M.P.). The axis is about 5 cm. long and 1·5 cm. in diameter (Fig. 1).

Transections of the material reveal a single-celled epidermis which superficially bears a few scattered hairs. The epidermis is followed by about ten-celled deep collenchymatous hypodermal zone. The tissue next to hypodermis is constituted by parenchymatous cells which have numerous large intercellular spaces. Furthermore, this zone is traversed longitudinally by numerous lysigenous air canals and vascular bundles.[1] The cells surrounding the air canals are smaller than those present between the canal region and collenchyma.

The vascular bundles are arranged in two more or less concentric whorls. A series of slightly smaller bundles are present at the peripheral region while somewhat larger bundles are present at points where the septa constituted by parenchymatous cells join one another. Rarely, vascular bundles may also be found on the arms of the septa away from the place of their confluence. Two simple vascular bundles can be seen nearly in the centre of the axis (Fig. 2).



FIGS. 1-3. Fig 1. Photograph of the petrified axis, × 1½. Fig. 2. T.S. of the same, × 5½. (*Xy. st*, xylem strand; 1, hair; 2, epidermis; 3, hypodermis; 4, air chamber; 5, septum; 6, vascular bundle.) Fig. 3. A. Structure of V.B. of *Nymphæa nouchali* Burm f. (white lily); B. Structure of V.B. of fossil axis. (*Ph*, phloem; *xy*, xylem; *xy. ca*, xylem cavity.)

The vascular bundles as in the living genus *Nymphæa*[2] are simple in construction. They are without cambium and bear only xylem and phloem elements collaterally. Primary xylem has disorganised and has probably given rise to schizogenous cavities. Each mature bundle consists of a few phlœm cells, some xylem elements and a large xylem cavity. This compares quite closely to the structure of the V.B. of the peduncle of *Nymphœa nouchali* Burm. f. (= *N. lotus* Hook. f. and Thoms.) (Fig, 3, A and B). Sclerenchymatous cells are altogether absent from the bundles.[3] Well-preserved xylem elements show spiral thickenings, having a diameter of about 59·4 μ, the distance between two spiral bands varies from 9·9 μ to 15·5 μ.

Abundance of air spaces along with poorly lignified tissue lends support to the fact that the axis belongs to a hydrophyte.

The presence of epidermal hairs, collenchymatous hypodermis, air chambers and the characteristic structure of the vascular bundles go to show that this axis probably belonged to some member of the Nymphæaceæ.

Department of Botany, B. S. TRIVEDI.
Lucknow University, C. L. VERMA.
Lucknow, *November* 19, 1969. K. AMBWANI.

---

1. Conard, H. S., *The Waterlilies* (A Monograph of the genus *Nymphæa*), 1935, p. 56.
2. Maynard, F. and Moseley, J. R., "Morphological studies of the Nymphæactæ," *Phytomorphology*, 1965, **15**, 55.
3. Metcalfe and Chalk, *Anatomy of Dicotyledons*, 1950, Vols. I & II.

REVIEWS AND NOTICES OF BOOKS

Degradation of Herbicides. Edited by P. C. Kearney and D. D. Kaufman. (Marcel Dekker, Inc., 95, Madison Avenue, New York, U.S.A.), 1969. Pp. xi + 394. Price $ 18.75 or £ 8–18 *sh.* 0 *d.*

Herbicides are making an ever-increasing contribution to modern agriculture, and consitute one of the most economically significant groups of pesticides on the commercial market. The fate of the herbicides, and in a larger sense, of all organic pesticides in our environment, is a subject of intense investigation and some controversy. This is a comprehensive book on the chemistry of organic herbicide degradation.

The contents of this book are: Phenoxyalkanoic Acids, by M. A. Loos; *s*-Triazines, by Enrico Knuesli, Dagmar Berrer, Gerard Dupuis, and Herbert Esser; The Substituted Ureas, by Hans Geissbuhler; Methyl- and Phenylcarbamates, by Richard A. Herrett; Thiolcarbamates, by S. C. Fang; Chloroacetamides, by Ernest G. Jaworski; Amitrole, by Mason C. Carter; The Chlorinated Aliphatic Acids, by C. L. Foy; Trifluralin and Related Compounds, by G. W. Probst and J. B. Tepe; Diquat and Paraquat, by H. H. Funderburk, Jr.; The Benzoic Acid Herbicides, by C. R. Swanson; and Herbicide Photodecomposition, by Donald G. Crosby and Ming-Yu Li.

The contributors to this volume are international authorities who have compiled tde most significant results from 20 years of research on the metabolic and chemical transformations of the herbicides; they have made liberal use of chemical formulas to characterize degradation reactions.

Biochemists, chemists, plant physiologists, microbiologists, and ecologists interested in the transformations and effects of foreign substances on biological systems will find many intriguing discussions in this book. C. V. R.

Annual Review of Genetics (Vol. 3). Edited by H. L. Roman. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1969. Pp. vii + 585. Price: U.S.A. $ 8.50 and elsewhere $ 9.00.

Volume 3 of this well-known series contains the following articles: Inborn Errors of Metabolism, by Alfred G. Knudson, Jr.; Globulin Polymorphisms in Man, by Arthur G. Steinberg; Human Population Structure, by N. E. Morton; Chromosomal Rearrangements and Speciation in Animals, by M. J. D. White; Experimental Polyploidy in Animals, by B. L. Astaurov; Developmental Genetics, by Donald D. Brown and Igor B. Dawid; Histones and the Control of Gene Expression, by Robert G. Martin; Some Aspects of the Competent State in Genetic Transformation, by Alexander Tomaz; Replication of the Bacterial Chromosome, by Friedrich Bonhoeffer and Walter Messer; Mutagenic Mechanisms, by John W. Drake; Some Aspects of Normal and Abnormal Cell Surface Genetics, by Edward A. Boyse and

Lloyd J. Old; Genetics of Polysaccharide Biosynthesis, by P. Helena Makela and B. A. D. Stocker; Phage Morphogenesis, by Myron Levine; Genetics of Single-Stranded DNA Bacteriophages, by David Pratt; The Genetic Control of Phage-Induced Enzymes, by Charles M. Rading; Genetic Regulatory Mechanisms in the Fungi, by Samson R. Gross; Chromosomal Activities in Rhynchosciara and Other Sciaridae, by C. Pavan and A. B. da Cunha; Wheat Cytogenetics, by E. R. Sears; Forest Genetics and Forest Tree Breeding, by W. J. Libby, R. F. Stettler, and F. W. Seitz; Evolution of Sex Chromosomes in Mammals, by Susumu Ohno; and Ultraviolet-Induced Mutation and DNA Repair, by Evelyn M. Witkin.

C. V. R.

Land and Soils. By S. P. Raychaudri. (National Book Trust, India, A-5, Green Park, New Delhi-16), Pp. 190. Price Rs. 5·25.

This is a publication in the series "India—the Land and People" produced by the National Book Trust, India, whose aim is to make available to the ordinary educated man and the non-specialist, knowledge about all aspects of the country, literary, cultural and scientific. The author who is a well-known agronomist has specially prepared this book in non-technical language to provide the general reader essential information about the country's soils, their types, their utility, causes of their deterioration, the ways of their improvement, etc. The book is amply illustrated and contains useful data and statistics.

A. S. G.

Fifty Years' Progress in Rice Research: Golden Jubilee Volume. (Mahatma Phule Krishi Vidyapeeth, College of Agriculture, Poona-5), Pp. 230. Price Rs. 10·00.

On the occasion of the Golden Jubilee (1919-1969) of the Rice Breeding Station, Karjat, Kolaba, Maharashtra, the Mahatma Phule Krishi Vidyapeeth has brought out a souvenir volume under the title *Fifty Years' Progress in Rice Research.* The book contains eleven informative articles on various aspects of rice research which will be of practical use to workers in this area. The volume also contains some interesting reminiscences and reflections contributed by those who have been connected with this Rice Research Station.

A. S. G.

Dictionary for Agricultural Chemistry. By A. Sankaram. (Oxford and IBH Publishing Company, Oxford Building, N-88, Connaught Circus, New Delhi-1), Pp. 213. Price Rs. 12·50.

The present book is a revised and enlarged edition of the author's earlier publication the *Glossary in Soil Science and Agricultural Chemistry.* In this edition besides many new definitions and explanatory notes, there are included analytical constants, conversion factors, etc., which will be useful to students of agricultural chemistry and agronomy in the laboratory or in the field. Although the terminology has not been arranged in any conventional order, an alphabetical index has been provided.

A. S. G.

ANNOUNCEMENTS

Award of Research Degree

Andhra University has awarded the Ph.D. degree in Applied Mathematics to Shri P. K. Subba Rao; Ph.D. degree in Chemistry to Shri P. Satyanarayana; Ph.D. degree in Geology to Shri R. Dhana Raju.

Institution of Chemists (India) Associateship Examination, 1971

The Twenty-First Associateship Examination of the Institution of Chemists (India) will be held in November 1971. The last date for Registration is 30th November 1970. Further enquiries regarding this and for Membership may be made to the Honorary Secretary, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

National Symposium on Radiation Physics

A National Symposium on "Radiation Physics" will be held at Trombay from November 9 to November 12, 1970 under the auspices of the Bhabha Atomic Research Centre, Bombay-85. The topics to be covered are: (*i*) Interaction of Radiation with Matter, (*ii*) Radiation Transport, (*iii*) Radiation Dosimetry, (*iv*) Environmental Radioactivity, (*v*) Units and Standards.

Scientists wishing to participate are requested to contact Shri K. Santhanam, Secretary, National Symposium on Radiation Physics, Health Physics Division, Bhabha Atomic Research Centre, Bombay-85.

The last date for submission of papers and abstracts is September 1, 1970.

Books Received

Kinetics and Mechanisms of Polymerization Series (Vol. I)—*Vinyl Polymerization* (Part II). Edited by G. E. Ham. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), Pp. xiii + 416. Price $ 22.50.

Methods in Free-Radical Chemistry (Vol. 2). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016). 1969. Pp. xi + 242. Price $ 12.75.

Chemistry of Acetylenes. Edited by H. G. Viehe. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1969. Pp. xv + 1298. Price $ 59.50.

Organic Photochemistry (Vol. 2). Edited by O. L. Chapman. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1969. Pp. xv + 230. Price $ 13.75.

Solid State Surface Science (Vol. I). Edited by Mino Green. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), Pp. xii + 420. Price $ 18.50.

Fluorine Chemistry Reviews (Vol. 4). Edited by Paul Tarrant. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1969. Pp. vi + 203. Price $ 16.50.

Methods in Free-Radical Chemistry (Vol. I). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1969. Pp. xi + 208. Price $ 11.75.

The Mushroom Hand-book. By L. C. C. Krieger. (Dover Publications, Inc., 180, Varick Street, New York, N.Y.), 1969. Pp. vii + 560. Price $ 3.95.

Understanding Physical Chemistry. By P. L. Soni and H. C. Sharma. (Sultan Chand and Sons, Amir Chand Marg, Delhi-6); (Vol. 1): 1969. Pp. 208; Price Rs. 4·00; (Vol. II): 1970. Pp. 256. Price Rs. 6·50.

CSIR Zoological Monograph I—Indian Thysanoptera. By T. N. Ananthakrishnan. (Publications and Information Directorate, C.S.I.R., New Delhi-12), 1969. Pp. 171. Price Rs. 26·00.

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Batterby. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1969. Pp. x + 432. Price $ 26.50.

Basic Infrared Spectroscopy. By J. H. Van Der Mass. (Heyden and Son Ltd., Spectrum House, Alderton, Crescent, London, N.W. 4), 1969. Pp. vii + 108. Price $ 3.50 or £ 1.10.0.

Nucleation. Edited by A. C. Zettemoyer. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1969. Pp. xii + 606. Price $ 29.50.

Treatise on Coatings (Vol. 2.). Part I—*Characterization of Coatings: Physical Techniques.* Edited by R. R. Myers and J. S. Long. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1969. Pp. xxi + 669. Price $ 39.75.

Annual Review of Nuclear Science (Vol. 19). (Annual Reviews, Inc., 4139, El Camino Way, California 94306, U.S.A.), 1969. Pp. v + 635. Price: U.S.A. $ 8.50; Elsewhere $ 9.00.

English Translation of Bharatiya Jyotish Sastra—History of Indian Astronomy (Part I)—*History of Astronomy During the Vedic and Vedanga Periods.* By S. B. Dikshit. (The Director, Regional Meteorological Centre, Calcutta), Pp. xxxiv + 147. Price Rs. 12·50.

Fundamentals of Agricultural Microbiology. By K. C. Mahanta. (Oxford and IBH Pub. Co., Park Hotel Bldg., 17 Park St., Calcutta-16), 1969. Pp. vi + 416. Price Rs. 16·00.

Algebrdia Geometry—Papers Presented at the Bombay Colloquium 1968. (Tata Institute of Fundamental Research, Bombay-5; Oxford University Press, Oxford House, Mount Road, Madras-6), 1969. Pp. viii + 426. Price Rs. 75·00.

A Text-Book of Bacteriology. By A. K. Dutta. (Bharati Bhawan, Patna-1), 1970. Pp. iv + 184.

Annual Review of Entomology (Vol. 15). (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1970. Pp. vii + 502. Price: U.S.A. $ 10.00; Foreign $ 10.50.

Gasdynamics (Vol. I)—*Non-Equilibrium Flows* (Part II). By P. P. Wegener. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1970. Pp. xi + 236. Price $ 13.50.

High Magnetic Fields and Their Applications. (The Institute of Physics and the Physical Society, 1, Lowther Garden, Prince Consort Road, London S.W. 7), 1969. Pp. 168. Price $ 3.60.

Metric Change in India. Edited by Lal C. Verman and Jainath Kaul. (Indian Standards Institution, 9, Bahadur Shah Zafar Marg, New Delhi-1), 1970. Pp. xxvi + 529. Price Rs. 60·00; or £ 6.0.0; or $ 15.00.

1997-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

THE PROBLEM OF THE BASEMENT IN MYSORE STATE

C. S. PICHAMUTHU

Department of Mines and Geology, Bangalore-1

CAPTAIN T. J. NEWBOLD (1844, p. 145) was one of the earliest to investigate the rock-formations of Mysore State and to distinguish the schistose from the gneissose rocks. In 1886, R. Bruce Foote named the schistose rocks as 'Dharwar' from the district in Mysore State, where he recognised them as constituting a distinct and separate 'system' (Foote, 1888, p. 41).

Foote was probably the first geologist who thought that the gneiss formed the basement on which the Dharwars were deposited. R. D. Oldham (1893, pp. 23–24) was also of this view. T. H. Holland (1902, p. 74) generally agreed with Foote, though he had some doubts as to whether the considerably folded Dharwar rocks of the Kolar Schist belt could be younger than the much less deformed Peninsular gneiss. J. M. Maclaren (1906, p. 107) also concluded that in the Gadag belt of Dharwar schists, the gneisses were the fundamental rocks on which the Dharwars were laid down. He noticed, however, that there were some gneissic intrusions along the cleavage planes of the schists. C. S. Middlemiss (1917, p. 197) also favoured the view that the Dharwars were deposited unconformably on the gneisses; according to him the gneissic intrusions into the schists were probably caused by local re-fusion or plastic deformation and penetration.

Geological work done in Mysore State from 1899 onwards by the officers of the Survey under the Directorship of W. F. Smeeth led to some very divergent views on this question of age relationship between the schists and the gneisses. They found that the granites and gneisses were intrusive into the schists and so did not form the basement for the Dharwars. According to Smeeth (1901, p. 19), no rocks older than the Dharwars could be definitely recognised anywhere in Mysore State. Fermor (1909, p. 998) also noticed intrusive contacts and, therefore, agreed with Smeeth that Dharwars were the oldest rocks, and that the associated gneisses were intrusive into the Dharwars.

That the gneisses formed the basement was generally accepted until certain evidences were produced in Mysore to show that they were intrusive into the Dharwars. The elongated and often irregular or angular inclusions of amphibolite and schists in the gneiss were considered to be the unassimilated remnants of Dharwar rocks which had been caught up during the intrusion of the Peninsular gneiss. This reversed the relative age relationship and made the Peninsular gneisses younger than the Dharwars. If this is the correct interpretation, then on what solid base were the Dharwar rocks laid down? Do the Lower Dharwars which are composed of acid and basic volcanic flows constitute the earliest formed rocks of earth history, or were these lavas erupted on a very ancient gneiss platform which represents the primordial crust? In the oldest basic volcanic rocks pillow structures have been recognised, and this indicates that these flows were of submarine origin. Associated with these volcanic rocks there are also ferruginous cherts and siliceous schists which represent the primeval sediments. The Lower Dharwars cannot, therefore, be the oldest rocks in the region.

As already mentioned, one of the reasons for considering the Peninsular gneiss as intrusive into the Dharwar Schists was the occurrence of numerous xenolithic inclusions of amphibolitic and schistose rocks in the gneiss. According to Sampat Iyengar (1920, p. 13), the Peninsular gneiss affords abundant evidences of intrusion and bristles to a variable extent with caught up lenses, patches and fragments of the Dharwar schists. In a number of places contact metamorphic phenomena can be noticed. Is his Presidential Address to the Geology Section of the Indian Science Congress, Fermor (1919) made the following categorical statement: 'All the evidence I have seen forces me to the same conclusions as Dr. Smeeth, *viz.*, that the Dharwars are the oldest rocks wherever they occur, and that the associated gneisses and gneissose granites are intrusive in their relationships.'

B. P. Radhakrishna (1967, pp. 102–103) has recently expressed the view that the amphibolitic and schistose inclusions found in the gneisses represent basic igneous rocks and sediments which are older than the Dharwars, and that the Peninsular gneisses as a whole are not intrusive into the Dharwars. Neither, according to him, are there undisputed evidences of any granitic intrusion into the Dharwars. He is of the opinion that the whole complex of granites and gneisses with lenses and patches of an earlier series of sediments and basic igneous rocks, forms the basement on which the Lower Dharwars rest. Geological thought on this question of the basement appears, therefore, to have made one complete circle and come back to the views held by the earliest workers.

There is need, however, to investigate this question further with great thoroughness. The crux of the problem appears to be whether the xenoliths in the gneisses and granites are fragments of Dharwar rocks or of an earlier series. It is improbable that conclusive field evidence can be obtained for the existence of such an older series of schists; at least, at the present time, there is none. Petrographic methods may also not yield any definite results. Radiometric dating could throw some light; but, on the other hand it may not, if the dates obtained give only the age of the latest episode of metamorphism.

The localities in Mysore State, where earlier geologists have reported instances of intrusion of Peninsular gneiss into schists, will have to be re-examined, and their conclusions reassessed, if necessary. One such area is a part of the Shimoga schist belt where the Peninsular gneiss apparently cuts east to west right across, and completely separates rock formations whose trends are north to south. On either side of the Tarikere valley, the schist belt has been abruptly terminated. The schist outcrops projecting into the gneisses at both ends appear to have been once continuous. There are also schist islands in the gneiss which look like links connecting the severed parts of the belt. On the face of it, the geology of this area cannot be satisfactorily interpreted in any other way except that of considering the Peninsular gneiss as having intruded the Shimoga belt of Dharwar rocks, and sundered a sequence of schists, quartzites, and conglomerates.

Sampat Iyengar (1920) has also cited several localities in Mysore State where, according to him, there are clear evidences of granites and gneisses intruding the schists. All these areas will also have to be investigated to determine whether the Peninsular gneiss as we know it at present, is younger or older than the Dharwars.

An important evidence for intrusion is the termination of a succession of sedimentary strata of differing ages by a rock like gneiss. A good example is furnished by the map of part of the Sausar Series given by West (1933) in his paper on the streaky gneisses of the Nagpur District. The intrusive relation of the gneisses to the members of the Sausar Series can be made out from this map since the whole sequence of the Sausars gets cut out step by step towards the east, until the gneisses come into contact with the big central outcrop of the Bichua stage. In Mysore State there is fairly good evidence for inferring that as one proceeds northwards, one comes across progressively younger rocks (Pichamuthu, 1951, pp. 117–119). This sequence of Dharwars, from the oldest to the youngest, is found somewhere or other to be in contact with gneisses. Normally, this will have to be interpreted as an instance of the gneisses having intruded the Dharwars, unless, of course, the gneisses in northern Mysore are different from, and younger than, the gneisses occurring in the south; or, if the younger Dharwar beds have successively overlapped the older strata. There is no evidence at present, however, for either of these alternatives.

No conclusive light has also been thrown on the relative ages of the Dharwar schists and Peninsular gneisses by geochronological data which are available; if anything, they favour an older age for the schists. Hornblende schists from the Hutti Gold Mine and Channagiri have given ages of 3,295 ± 200 m.y., and 2,631 m.y. respectively (Sarkar and Miller, 1969). According to Aswathanarayana (1968, p. 591) the Dharwars bear the impress of three episodes of folding, metamorphism, and emplacement of granites, the first of which happened about 3,000 m.y. ago. This corresponds to Phase I (c. 3,000-2,800 m.y.) of Dharwar orogeny, metamorphism, and granitisation as envisaged by Sarkar (1968, p. 17). The Dharwar schists near Mysore have given an age of 3,000 m.y. (Crawford and Compston, 1967, p. 33). According to Ramamurthy and Sadashivaiah (1967, p. 73) the Lower Dharwars must be older than or equal to about 3,100 m.y. Vinogradov and Tugarinov (1968) determined the ages of Kolar amphibolite and Chitaldurg galena as 2,900 ± 200 m.y.

On the other hand, Peninsular gneisses of Mysore State have given a comparatively lower age. According to Crawford and Compston (1967, p. 33) Peninsular gneiss near Bangalore is 2,635 ± 45 m.y. old, and gneiss near Mysore is 2,800 m.y. old. A similar age of 2,700 ± 100 m.y. was also obtained by Vinogradov and Tugarinov (1968) for a migmatitic gneiss near Bangalore. The age of Peninsular gneiss as given by Ramamurthy and Sadashivaiah (1967, p. 73) is 2,480 m.y., and that by Sarkar (1968, p. 17) is 2,635 m.y. In Crawford's latest paper (1969, p. 134) the Peninsular gneiss of Bangalore is 2,580 ± 50 m.y. old.

The Dharwars occur at the present time in bands of varying dimensions which are remnants of a formation that probably covered a much more extensive area in Mysore State. Both the Dharwar schists and the Peninsular gneisses have together been subjected to intense tectonic disturbances with the result that they now appear to be interbedded and interfolded. We are dealing with very ancient rocks whose ages range from about 2,000–3,000 million years. During this long period of time several orogenic cycles must have occurred and left their impress both on the composition and disposition of the rock sequences. There are variations in stratigraphical succession, dislocations on a gigantic scale, and differences in metamorphic grade. It would be difficult, therefore, to identify with any certainty, and differentiate between the original crustal basement and the first-formed lava flows or sediments. With the help of available field criteria such as current bedding, graded bedding, pillow structures, drag folds, etc., the stratigraphy of the unfossiliferous Dharwar formations should be worked out, and an accurate stratigraphical column set up, just as Fermor did for the Sausar series. Careful search will then have to be made in the neighbourhood of the oldest Dharwar rocks for vestiges of the basement (Pichamuthu, 1968, pp. 199–200).

---

1. Aswathanarayana, U., "Metamorphic chronology of the Precambrian provinces of South India," *Canadian Jour. Earth Sci.*, 1968, **5**.
2. Crawford, A. R., "Reconnaissance Rb-Sr dating of the Precambrian rocks of Southern Peninsular India," *Jour. Geol. Soc. Ind.*, 1969, **10** (2).
3. — and Compston, W., "New Rb-Sr age determination for the Precambrian of South India and Ceylon," *Conference on Geochronology of Precambrian Stratified Rocks*, *University of Alberta, Abstract*, 1967, p. 33.
4. Fermor, L. L., "The manganese-ore deposits of India," *Mem. Geol. Surv. Ind.*, 1909, **37**.
5. —, "Some problems of ore genesis in the Archæan of India," *Presidential Address*, *Section of Geology*, *Ind. Sci. Cong.*, *Proc. Asiatic Soc.*, Bengal, 1919, **15**.
6. Foote, R. B., "Notes on the geology of parts of Bellary and Anantapur Districts," *Rec. Geol. Surv. Ind.*, 1886, **19**.
7. —, "The Dharwar system, the chief auriferous rock series in South India," *Ibid.*, 1888, **21**.
8. Holland, T. H., Notes on rock specimens collected by Dr. F. H. Hatch on the Kolar Gold Field," *Mem. Geol. Surv. Ind.*, 1902, **33**.
9. Maclaren, J. M., "Notes on some auriferous tracts in Southern India," *Rec. Geol. Surv. Ind.*, 1906, **34**.
10. Middlemiss, C. S., "Complexities of Archæan geology in India," *Presidential Address*, *Section of Geology*, *Ind. Sci. Cong.*, *Jour. Proc. Asiatic Soc.*, Bengal, 1917, **13**.
11. Newbold, T. J., "Summary of the geology of Southern India," *Jour. Roy. Asiatic Soc.*, 1844, **8**.
12. Oldham, R. D., *A Manual of the Geology of India and Burma*, Second Edition, Calcutta, 1893.
13. Pichamuthu, C. S., "Some observations on the structure and classification of the Dharwars of Mysore State," *Curr. Sci.*, 1951, **20**.
14. —, "The Dharwar basement," *Proc. 55th Ind. Sci. Cong.*, 1968, Part 3.
15. Radhakrishna, B. P., "Reconsideration of some problems in the Archæan complex of Mysore," *Jour. Geol. Soc. Ind.*, 1967, **8**.
16. Ramamurthy, V. and Sadashivaiah, M. S., "Rubidium-strontium age of charnockite and other rocks from the Precambrian complex, Mysore, India," *Conference on Geochronology of Precambrian Stratified Rocks*, *University of Alberta, Abstract*, 1967, p. 73.
17. Sampat Iyengar, P., "The acid rocks of Mysore, a study in intrusion, metamorphism and quantitative classification," *Bull. Mys. Geol. Dept.*, 1920, No. 9.
18. Sarkar, S. N., *Precambrian Stratigraphy and Geochronology of Peninsular India*, Dhanbad Publishers, India, 1968.
19. — and Miller, J. A., *Geochronology of the Precambrians of Southern India*, 1969 (In press).
20. Smeeth, W. F., "General report on the work of the Department for the years 1900 and 1901," *Rec. Mys. Geol. Dept.*, 1901, **3**.
21. Vinogradov, A. P. and Tugarinov, A. I., "Geochronology of the Indian Precambrian," *22nd Int. Geol. Cong. Report*, 1968.
22. West, W. D., "The origin of the streaky gneisses of the Nagpur District," *Rec. Geol. Surv. Ind.*, 1933, **67**.

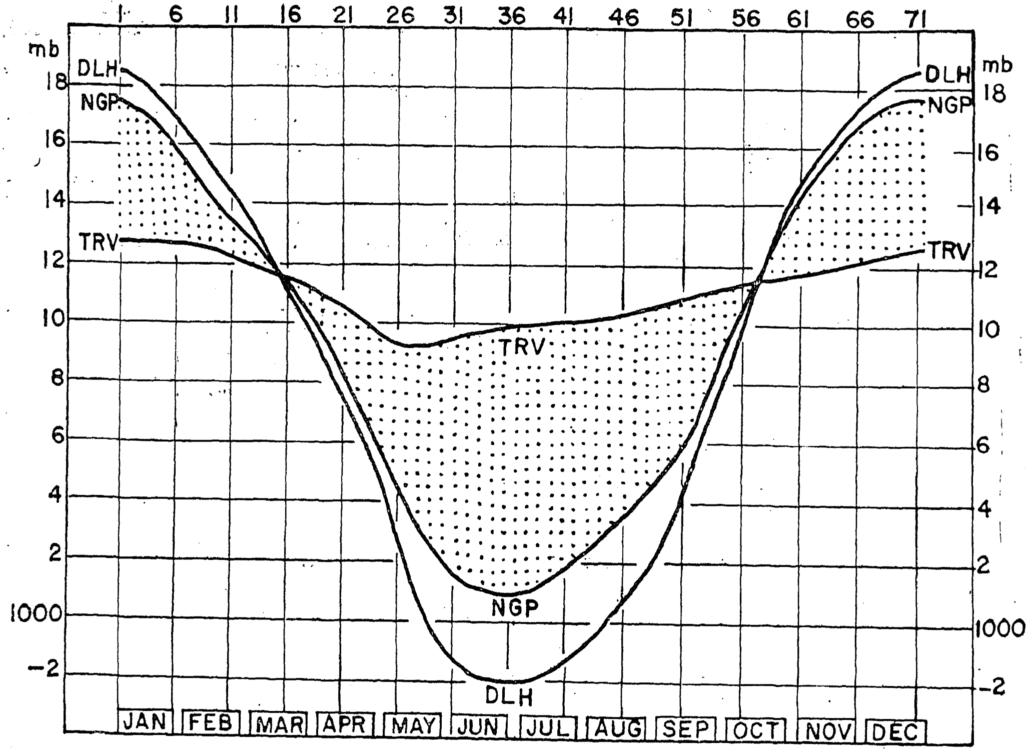
THE SEASONAL MARCH OF SURFACE PRESSURE GRADIENTS ACROSS INDIA AND THE SOUTH-WEST MONSOON

R. ANANTHAKRISHNAN

Institute of Tropical Meteorology, Poona

IT is well known that the seasonal weather features of the Indian sub-continent are associated with corresponding changes in the pressure gradients across the country. In the summer monsoon months the surface pressure increases from north to south while in the winter months the reverse situation obtains. March and October are the transitional months.

2. An insight into the manner in which the reversal of pressure gradients across the country is effected is obtained by studying the pressure variations at the three stations Trivandrum (08° 29′ N, 76° 57′ E.), Nagpur (21° 09′ N, 79° 07′ E.) and New Delhi (28° 35′ N, 77° 12′ E.), which lie close to the central meridian of 77° E. across India. The choice of these stations is not entirely arbitrary. Trivandrum in the extreme south and Nagpur in the central parts of the country taken together give an idea of the pressure gradient across peninsular India. Similarly New Delhi in the north and Nagpur in the centre of the country provide a measure of the pressure gradient over north India.



PENTAD MSL PRESSURE VARIATIONS AT TRIVANDRUM, NAGPUR AND NEW DELHI

FIG. 1

3. The annual march of sea-level pressure at the three stations is shown in Fig. 1. The curves are based on normal pentad values of pressure reduced to sea-level at the three stations (IMD, 1965). The following points are noteworthy:

(*i*) The lowest and highest values of sea-level pressure, the epochs at which they occur and the annual range of pressure at the three stations are as given below :

Station	PPP (Max.) (mb)	Date	PPP (Min.) (mb)	Date	Range (mb)
Trivandrum	1012·7	15 Jan.	1009·1	15 May	3·6
Nagpur ..	1017·6	23 Dec.	1000·9	30 Jun.	16·7
New Delhi ..	1018·6	23 Dec.	998·0	30 Jun.	20·6

It is interesting to note that surface pressure continues to fall at Nagpur and New Delhi for one and a half months more after it has reached the minimum value at Trivandrum by the middle of May. This has an important bearing on the onset and advance of the southwest monsoon over the country.

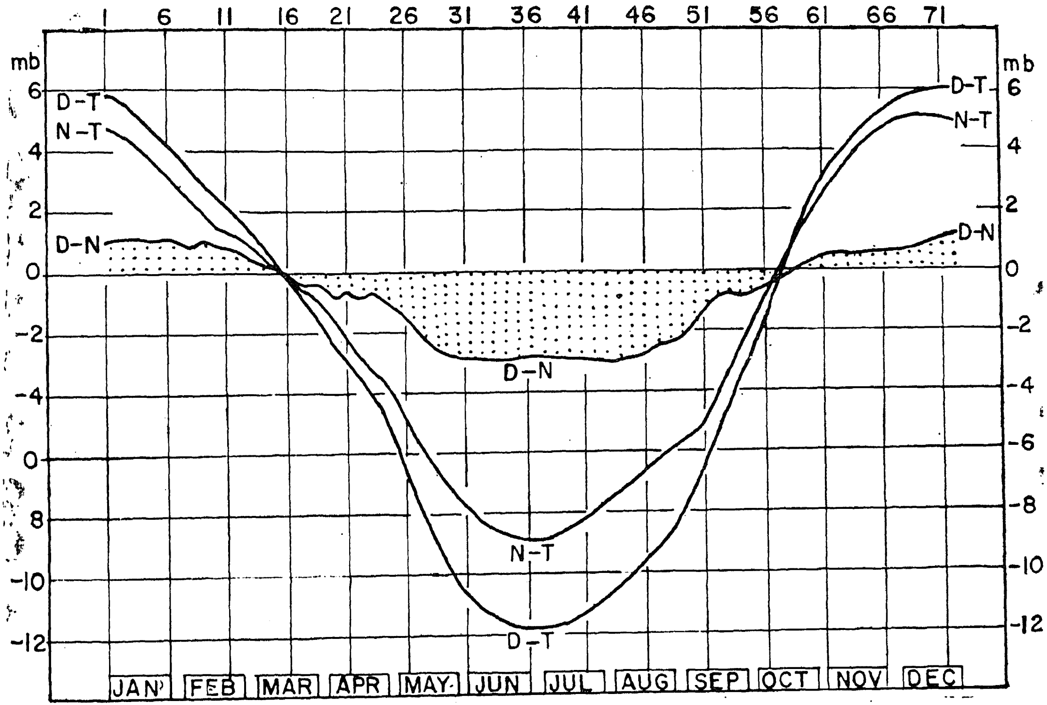
(*ii*) All the three pressure curves pass practically through a common point about the middle of March and again about the middle of October. Hence, pressure gradients across the country are practically zero at and near these two transitional epochs. These two epochs correspond to the transition from the winter to the summer type of pressure distribution and *vice versa*. The actual magnitudes of m.s.l. pressure at the three stations are :

	Mean sea-level pressure (mb) at		
	Trivandrum	Nagpur	New Delhi
15 March ..	1011·4	1011·3	1011·2
15 October ..	1011·4	1011·4	1011·1

It is seen that at the two transitional epochs the m.s.l. pressure at the three stations has practically the same value.

(*iii*) The summer type of pressure distribution obtains for about 7 months (mid-March to mid-October) and the winter type of gradient for 5 months.

4. The seasonal march of the pressure difference between pairs of stations which may be taken as a measure of the pressure gradients is depicted in Fig. 2. The figure shows that much larger pressure gradients prevail across India in the summer monsoon months of June, July and August as compared with the winter.



PENTAD MSL PRESSURE DIFFERENCE VARIATIONS BETWEEN TRIVANDRUM, NAGPUR AND NEW DELHI

FIG. 2

months of December, January and February. The following points are noteworthy:

(*i*) The pressure difference between Nagpur and Trivandrum (N-T) which is positive in the winter months attains its maximum value of 5·1 mb in the middle of December. From January till the end of April (N-T) decreases almost uniformly changing from positive to negative value by the middle of March. From the end of April till the beginning of June there is a steeper increase in the pressure gradient between Nagpur and Trivandrum. Even after the monsoon has set in on the Kerala coast by 1 June (the normal date of onset), the pressure gradient continues to increase over the peninsula although at a smaller rate. The maximum negative value of 9 mb for (N-T) is reached by the end of June or the beginning of July.

(*ii*) The positive pressure difference between Delhi and Nagpur (D-N) in winter attains the maximum value of 1·1 mb by the end of December. It remains nearly constant at this value till the end of February after which it begins to fall more or less uniformly till the end of April changing sign by mid-March. A steeper rate of fall of (D-N) occurs from the end of April till the end of May.

(*iii*) By the beginning of June (pentad 31) the pressure difference between Delhi and Nagpur reaches the maximum negative value of about 3 mb. It stays at this value till pentad 46 (mid-August) after which it begins to decrease. *The constancy of the pressure difference between Delhi and Nagpur from the beginning of June till the middle of August is a significant feature of the climatological pressure distribution over north India during the SW monsoon season.* During the first half of this period pressures are falling both at Delhi and Nagpur while during the second half pressures are rising. The rate of fall/rise of the pressure is the same at both the places during the period 1 June to 15 August so that the difference of pressure between the two stations remains constant.

(*iv*) From the middle of August the pressure gradient between Delhi and Nagpur begins to weaken rapidly till the middle of September; thereafter the gradient decreases at a slower rate reaching zero value by mid-October. Between Nagpur and Trivandrum the decrease of gradient is at a slower rate from mid-August to mid-September and at a steeper rate thereafter till mid-October.

5. The above facts lead to the following conclusions about the association between changes of sea-level pressure gradient across India and the south-west monsoon. The onset of the south-west monsoon over the Kerala coast occurs when the north-south pressure gradient across north India has reached its maximum value by the beginning of June. The pressure gradient across the peninsula continues to build up till about the first week of July, while the gradient between Delhi and Nagpur remains practically constant. During this period the monsoon advances northwards and westwards and establishes itself over the entire country. Thus the maximum pressure gradient across the country is reached in the first week of July which may, therefore, be regarded as the peak of the south-west monsoon season.

6. The next significant date in the history of the south-west monsoon is the middle of August when the pressure gradient across north India begins to weaken while the gradient across the peninsula has been continuously weakening after the first week of July. In a recent study (Ananthakrishnan, 1970) it has been shown that a rainfall minimum occurs at or near pentad 46 (16 August) at several stations over the west coast, central India and north India north of 16° N. It was suggested that this date should be regarded as the epoch of maximum northward extension of the monsoon circulation features before the southward retreat of the monsoon commences. This epoch coincides with the period of maximum frequency of occurrence of 'breaks' in the monsoon (K. Ramamurthi, 1969). During 'breaks' the monsoon trough on the sea-level chart shifts northward to the foot of the Himalayas and there is also a northward shift of the core of strong easterlies in the upper troposphere over the south of the peninsula. At the same time, rainfall decreases in the plains and increases at the foot of the Himalayas.

7. Despite the large number of studies on Indian rainfall, the existence of a minimum in the south-west monsoon rainfall around 16 August at a large number of stations which are widely separated spatially had not been realised till recently. This has been clearly brought out by the study of pentad rainfall curves of observatory stations based on data for the fifty-year period 1901–1950. The two rainfall maxima on either side of this minimum which occur in July/August and August/September are to be associated with the northward advance and southward retreat of the surface and upper air circulation features associated with the south-west monsoon.

8. With the reversal of the pressure gradients across the country by mid-October the south-west monsoon gives place to the north-east monsoon over the south of the peninsula. Pressure gradient between Delhi and Nagpur increases only very gradually after mid-October while it increases steeply between Nagpur and Trivandrum reaching the peak value by mid-December.

1. Ananthakrishnan, R., "Some salient features of the space-time variations of rainfall over India and neighbourhood," *Curr. Sci.*, 1970, **39**, 101.
2. Ind. Met. Dept., *Five-Day Normals of Pressure, Maximum and Minimum Temperatures and Relative Humidity*, 1965.
3. Ramamurthi, K., "Some aspects of the 'Break' in the Indian south-west monsoon in July and August," *IMD FMU Rep. No. IV*, 1969, **18**, 3.

ON THE OCCURRENCE OF INTERSTITIAL FAUNA IN THE INTERTIDAL SANDS OF SOME ANDAMAN AND NICOBAR GROUP OF ISLANDS

G. CHANDRASEKHARA RAO

Zoological Survey of India, 27, Chowringhee Road, Calcutta-13

THE marine interstitial fauna, inhabiting the intertidal zone on Indian coasts, is receiving considerable attention during recent years. Studies on the fauna inhabiting the beach sands of Waltair coast, during the years 1960–1963, have revealed the occurrence of several interesting invertebrate groups of animals. A comprehensive report on the results of the investigation, first of its kind in Indian waters, has already been published (Chandrasekhara Rao and Ganapati, 1968) and several species have been described as new to science.

During a brief faunistic survey of the Andaman and Nicobar group of islands, undertaken by the Zoological Survey of India in February to April 1969, the author had an opportunity to visit the archipelago and examine intertidal sands on the various isles located in the vicinity of North, Middle, South and Little Andamans and Car Nicobar island. No previous records of interstitial fauna are known from the archipelago and a detailed report of the fauna collected in the present survey is being published elsewhere. The present account deals with the preliminary results concerning the nature of the habitat, composition of the fauna and the relationship of the faunal element with the physiography of the islands.

NATURE OF THE HABITAT

In the majority of these islands, the coast is mostly rocky, with the cliffs almost descending right into the waters. The rocks and boulders in the intertidal zone are not covered with sufficient algal growths and as such, a rich community of algal fauna characteristic of rocky shores is missing. Some muddy beaches are also encountered, especially near the mangrove swamps located at the mouths of brooks. Except for a few islands, the sandy beaches are limited to certain patches occurring here and there between cliffs. The slope in several beaches is low and the amplitude of the tides is high, with the result a wide intertidal belt is exposed during low tides. The beach sand is mostly composed of silica except in those islands harbouring rich coral growths, where the sand is exclusively coralline. The colour of the sands vary from black and light-yellow to reddish-brown, while the coralline sands are purely white. The shape of sand-grains varies from spherical to angular. Except in a few cases, the sands are relatively heterogeneous, composed of coarse, medium and fine particles with a mean diameter of $> 500\,\mu$, $300–500\,\mu$ and $< 300\,\mu$, respectively. The bulk of the beach sands are fine, although the grain size tends to increase with depth. A small percentage of broken shells is mixed with sand, especially near the water's edge. The compactness of coralline beaches is low, due to the lightness of grains and the lack of cohesion between particles.

The climate is tropical, with heavy gales and rains. The temperature in the interstitial biotopes varied from 26° C. to 30° C. while the salinity of the interstitial water ranged between 29‰ and 33‰. The sands appear sufficiently rich in organic detritus.

COMPOSITION OF THE FAUNA

A quantitative estimation of the interstitial fauna inhabiting the various islands is made and an average percentage composition of the density of different groups is given in Table I.

TABLE I

Percentage composition of diverse groups of interstitial fauna inhabiting the intertidal sands of some Andaman and Nicobar islands

Group		North Andaman	Middle Andaman	South Andaman	Little Andaman	Car Nicobar	Combined average
Cœlenterata	..	0·5	..	4·0	3·0	..	1·5
Turbellaria	..	3·0	2·0	3·5	3·0	4·0	3·1
Nematoda	..	3·0	2·5	4·0	3·5	2·0	3·0
Gastrotricha	..	..	..	2·0	0·5	1·5	0·8
Nemertinea	..	1·5	0·5	0·5	0·5	1·0	0·6
Rotifera	..	0·5	1·0	2·0	..	..	0·7
Archiannelida	..	8·0	8·5	12·0	7·5	9·0	9·0
Polychæta	..	13·5	15·0	8·5	11·0	12·0	12·0
Oligochæta	..	1·5	3·0	1·0	1·0	0·5	1·4
Ostracoda	..	2·5	1·0	2·0	0·5	3·0	1·8
Copepoda	..	42·0	41·0	37·5	55·0	46·0	44·3
Isopoda	..	11·0	14·5	16·0	10·0	13·5	13·0
Amphipoda	..	5·0	6·5	3·5	2·5	4·0	4·3
Tardigrada	..	..	..	1·0	0·5	..	0·3
Acarina	..	2·5	1·5	2·0	0·5	2·0	1·7
Collembola	..	1·5	0·5	..	..	1·0	0·6
Mollusca	..	1·5	0·5	..	1·0	0·5	0·7
Echinodermata	..	2·5	2·0	0·5	..	..	1·0

The density of Protozoa could not be correctly assessed. The bulk of the fauna (nearly 80%) on the archipelago consists of Copepoda, Isopoda, Polychæta and Archiannelida, in the order of their abundance. The Amphipoda, Turbellaria and Nematoda nearly comprise 10% of the fauna. Other groups of animals are represented by very small numbers. No records of Kinorhyncha, Mystacocarida and Tunicata are made in the present survey.

A qualitative estimation of the fauna has indicated that Copepoda, Polychæta, Turbellaria, Nematoda and Archiannelida, in their order comprise the majority of the species; while all the other groups are limited to a very few species.

FAUNAL ELEMENT IN RELATION TO THE PHYSIOGRAPHY OF THE ISLANDS

The physiography of the islands presents certain inhospitable conditions for the development of typical interstitial fauna, influencing their density and distribution. In the majority of localities investigated, the density of fauna is relatively poor compared to the mainland fauna reported on Waltair coast. The absence of extensive beaches coupled with the nature of finer substrate, seems to retard the colonization of the fauna. In several beaches, the interstices are literally choked with fine sand, mud, detritus or coralline powder, where a critical level has reached and this may act as a detrimental factor for the faunal proliferation and distribution. In certain areas with sufficient coarse sand containing well-developed interstitial fauna, a 100 cc. sand sample yielded 600–750 specimens of diverse groups compared with 900–1150 specimens on the Waltair coast.

In beaches with muddy sand, the fauna mainly comprises of poor populations of ciliates, nematodes, rotifers and oligochætes. The interstitial Turbellaria, Nematoda and Gastrotricha, normally forming the typical component of the intertidal sands, are poorly represented on the archipelago.

The quantitative and qualitative estimations have also indicated that the composition of the faunal element does not differ very much from island to island, despite a variation in the nature of the habitat and their isolation by the seas. Few species have been found endemic, with restricted distribution to certain isles of the archipelago. However, the present study has revealed that several interstitial species discovered on these islands have already been reported on the Waltair coast, throwing considerable light on the geographical distribution of the fauna.

The author is grateful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for his interest in the work and affording an opportunity to participate in the Survey and to Shri T. D. Soota, Leader of the party, Andaman and Nicobar Survey, 1969, for facilities and encouragement on the tour.

---

1. Chandrasekhara Rao, G. and Ganapati, P. N. "The marine interstitial fauna inhabiting the beach sands of Waltair coast," *Proc. natn. Inst. Sci. India*, 1968, **34** (2), 82.

LETTERS TO THE EDITOR

DIELECTRIC PROPERTIES OF SOLUTIONS OF CERTAIN NITRATES IN ETHYL ALCOHOL

THERE has been, as yet, no satisfactory theory for the behaviour of ionic salts in solution at various concentrations. Dielectric properties form one branch of this study. While the dielectric behaviour of the large number of salts dissolved in water has been experimentally investigated, the dielectric properties of the same salts dissolved in other media are available only in very few cases. For example, with alcohol as solvent, the dielectric behaviour of only 5 salts, namely, NaI, LiI, $MgCl_2$, LiCl, and $LaCl_3$ were investigated previously.[1]

The dielectric properties of six nitrates of the transition group elements dissolved in ethyl alcohol are studied in this laboratory. The investigations are carried out at 3·14 cm. wavelength region by the method adopted by Harris and O'Konski.[2] The experimental details are described fully elsewhere.[3]

TABLE I

Dielectric properties of solutes in ethyl alcohol at 3·14 cm.

Solute	Concentration	ϵ'	ϵ''obs.	ϵ''correct	λ_s	ϵ_s
Mn $(No_3)_2$	0·25	4·66	4·46	2·73	18·63	20·185
	0·5	4·62	4·52	2·37	17·72	17·99
	0·75	4·58	4·55	1·82	15·04	13·282
	1	4·57	4·56	1·44	12·22	10·174
Co $(No_3)_2$	0·25	4·65	4·02	2·71	18·91	20·97
	0·5	4·61	4·32	2·44	18·68	19·13
	0·75	4·57	4·45	2·11	17·91	16·61
	1	4·53	4·47	1·70	16·17	12·89
Cu $(No_3)_2$	0·25	4·67	3·62	2·65	17·7	17·6
	0·5	4·64	3·92	2·19	15·99	16·05
	0·75	4·61	4·04	1·93	14·78	13·286
	1	4·58	4·34	1·80	13·22	11·314
Cd $(No_3)_2$	0·25	4·68	3·92	2·61	17·07	18·87
	0·5	4·65	3·95	2·35	16·40	16·93
	0·75	4·61	4·04	2·04	15·63	14·76
	1	4·57	4·14	1·78	15·10	13·13
Cr $(No_3)_2$	0·25	4·69	3·94	2·63	16·86	18·81
	0·5	4·65	4·34	2·24	15·63	15·8
	0·75	4·63	4·45	1·89	13·80	13·80
	1	4·60	4·58	1·62	12·72	12·72
Ni $(No_3)_2$	0·25	4·66	3·82	2·51	17·22	18·49
	0·5	4·63	4·24	2·24	16·39	16·35
	0·75	4·61	4·4	1·93	14·78	13·70
	1	4·59	4·51	1·71	13·77	12·09

From the experimental values of ϵ' and ϵ'', the static dielectric constant and the relaxation wavelength are determined at the different concentrations on the basis of the debye dispersion formula and high frequency dielectric constant $\epsilon_\infty = 4·2$ for all solutions.

The results are tabulated in Table I.

The results indicate in general that the depression of the dielectric constant and the relaxation wavelength from the corresponding pure solvent values increase with concentrations in each case, but the variation is not linear with concentration. An attempt is being made to explain the depression in the static dielectric constant using Glueckauf's[4] theory.

We are indebted to the Council of Scientific and Industrial Research for financial assistance.

Dept. of Physics, Andhra Univ. Post-Graduate Centre, Guntur-5, *December* 31, 1969.

P. SUBRAHMANYA SASTRY.
D. PREMASWARUP.

---

1. Hasted, J. B. and Roderick, G. W., *J. Chem. Phys.*, 1958, **29**, **17**.
2. Harris, F. E. and Konski, T., *Rev. Scient. Instruments*, 1955, **26**, 482.
3. Krishna Mohan Rao, P. S. and Premaswarup. D., *Jour. Pure and Appl. Phys.*, 1967, **5**, 12, 581.
4. Glueckauf, E., *Trans. Faraday Soc.*, 1964, **60**, 1637.

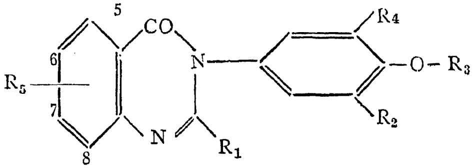
2-METHYL-3- (3-5-DIMETHYL-4-HYDROXYPHENYL)-3, 4-DIHYDROQUINAZOLIN-4-ONE AND ITS DERIVATIVES

DURING the course of cur work on quinazolinones,[1,2] we synthesized 2-methyl-3-(3, 5-dimethyl - 4 - hydroxyphenyl) -3, 4-dihydroquinazolin-4-one which showed somewhat better hypnotic activity in rats compared with methaqualone, 2-methyl-3-o-tolyl-3, 4-dihydroquinazolin-4-one, but its toxicity data were discouraging.

Attempts to modify the molecule with a view to retaining its hypnotic property and reducing its toxicity on the lines: (*a*) of replacing the methyl group in position 2 with hydrogen, ethyl, propyl, isopropyl and butyl, (*b*) of substituting the quinazolinone ring with chlorine, bromine, nitro or amino; and (*c*) of replacing the methyl groups on the phenyl group at position 3 with chlorine or bromine, met with no success. Most of the modifications resulted in complete loss of hypnotic activity; only the O-acyl derivatives of the parent molecule showed proportionately reduced activity, with similar toxicity pattern.

The compounds synthesized in this context are listed in Table I. Excepting the amino, O-acyl and O-alkyl derivatives (compounds: 17, 18, 7, 8, 9 and 10), the others were synthesized by heating the corresponding 3, 1-benzoxazin-4-one with the appropriate amine or its hydrochloride at 150–180° for 30 minutes.

TABLE I



No.	R$_1$	R$_2$	R$_3$	R$_4$	R$_5$	m.p. °C.*	Nitrogen %	
							Found	Calc.
1	CH_3	CH_3	H	CH_3	H	225-27	9·84	10·00
2	H	CH_3	H	CH_3	H	234-36	10·55	10·53
3	C_2H_5	CH_3	H	CH_3	H	222-24	9·48	9·53
4	C_3H_7	CH_3	H	CH_3	H	236-38	9·23	9·09
5	C_3H_7 (iso)	CH_3	H	CH_3	H	231-32	9·30	9·09
6	CH_3	H	H	CH_3	H	285-88*	9·39	9·26
7	CH_3	CH_3	$COCH_3$	CH_3	H	222--23	8·66	8·69
8	CH_3	CH_3	COC_2H_5	CH_3	H	187-88	8·38	8·34
9	CH_3	CH_3	COC_3H_7	CH_3	H	164-66	7·89	8·00
10	CH_3	CH_3	CH_3	CH_3	H	245-48†	8·31	8·48
11	CH_3	CH_3	H	CH_3	Cl (5)	266-69	9·09	8·91
12	CH_3	CH_2	H	CH_3	Cl (6)	261-62	9·03	8·91
13	CH_3	CH_3	H	CH_3	Cl (7)	280-82	9·1	8·91
14	CH_3	CH_3	H	CH_3	Br (6)	258-60	7·53	7·80
15	CH_3	CH_3	H	CH_3	NO_2 (6)	274-76	13·00	12·92
16	CH_3	CH_3	H	CH_3	NO_2 (7)	283-85	12·83	12·92
17	CH_3	CH_3	H	CH_3	NH_2 (6)	308-10	14·29	14·23
18	CH_3	CH_3	H	CH_3	NH_2 (7)	321-23	14·22	14·23
19	CH_3	Cl	H	Cl	H	282-84 (d)	8·69	8·73
20	CH_3	Br	H	Br	H	Sinters $>$ 260 :	6·30	6·27

* All melting points are uncorrected. † The analytical data are for the hydrochlorides.

The amino compounds were derived from the corresponding nitro compounds by reduction with iron and ammonium chloride. The O-acyl and O-alkyl derivatives were prepared by standard methods of acylation and alkylation.

A few typical experiments are described below.

2-Methyl-3-(3, 5-dimethyl-4-hydroxyphenyl)-3, 4-dihydroquinazolin-4-one.—2-Methyl-3, 1-benzoxazin-4-one (6·4 g.; 0·04 mole) and 3, 5-dimethyl-4-hydroxyaniline hydrochloride (6·8 g.; 0·04 mole) were intimately mixed and heated at 150–160° for 1 hour. The reaction product was titurated with dilute hydrochloric acid (100 ml; 2 N). The insoluble solids were filtered off and then triturated with sodium bicarbonate solution (4 g.; 100 ml.). The crude title product (7·4 g.) thus obtained was crystallised from ethanol; m.p. 225–27°.

2-Methyl-3-(3, 5-dimethyl-4-acetoxyphenyl)-3, 4-dihydroquinazolin-4-one.—2-Methyl-3-(3, 5-dimethyl-4-hydroxyphenyl)-3, 4-dihydroquinazolin-4-one (2·8 g.; 0·02 mole) was taken in pyridine (10 ml.) and treated with acetic anhydride (2 ml.). The reaction mixture was heated at 70° for 20 minutes, cooled, poured into ice and neutralised with ammonia. The solid that separated out was crystallised from aqueous ethanol; m.p. 222–23°.

Sarabhai Research Centre,
Wadi Wadi, Baroda,
December 10, 1969.

S. SOMASEKHARA.
(MISS) V. S. DIGHE.
N. M. PATEL.
S. L. MUKHERJEE.

---

1. Somasekhara, S., Dighe, V. S. and Mukherjee, S. L., *Ind. J. of Pharmacy*, 1965, **27**, 12.
2. —, — and —, *Curr. Sci.*, 1966, **35**, 594.

OXIDATION OF HYDRAZINE SULPHATE BY THALLIUM (III) IN AQUEOUS SULPHURIC ACID

THE kinetics of the oxidation of hydrazine sulphate by a variety of metal ions such as Fe(III),[1-5] Ce(IV),[2,3,6] V(V),[2] Ag(I),[11] Cu(II),[8] Mo(VI),[9] Co(III)[12] and also metal oxides[7,10] have been studied. Although the oxidation of this substrate with Tl(III) has been studied,[2] this was essentially a study of the principal nitrogenous products and the kinetic aspects of this reaction have not been fully clarified. We present, in this communication, the results of our investigation on the Tl(III) oxidation of hydrazine sulphate in aqueous sulphuric acid. The reaction was followed by estimating the amount of unreacted Tl(III) at various time intervals by iodometry. The rate of this reaction is inconveniently fast even at laboratory temperatures. We have shown in a recent publication[13] that the rates of Tl(III) oxidations can be controlled by suitable additions of calculated quantities of sodium chloride. The reaction under study was therefore conducted in presence of 0·005 M NaCl. The reaction is of a clean first order in Tl(III) and also in hydrazine sulphate (Fig. 1, A and B). A plot of $1/k_1$ *versus* $1/[N_2H_4]$ is devoid of any intercept on the *y*-axis indicating the absence of any preformed complex unlike in the Co(III) oxidation of hydrazine sulphate.[12] The effect of acidity on the reaction was studied in the range 0·5 M to 2·0 M H_2SO_4. The reaction exhibits an inverse first-order dependence on $[H^+]$ in the region 0·5 M–2·0 M (Fig. 2, C). Added Na_2SO_4 (0·2 M to 2·0 M) increases the rate while $KHSO_4$ in the same range produces little variation in rate (Table I).

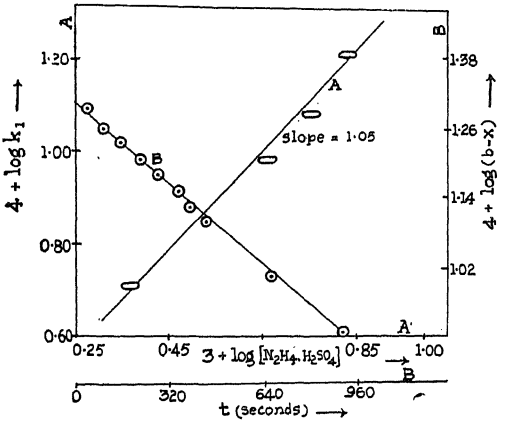


FIG. 1

These observations seem to rule out $[TlSO_4]^+$ as the reactive species and are indicative of either $[Tl(OH)]^{2+}$ or Tl^{3+} as the active species. If $[TlSO_4]_+$ indeed were to be the active species, the observed rate constant must have increased with increasing $[HSO_4^-]$. The inverse first-order dependence on $[H^+]$ would, of course, be observed for either species.

$$Tl^{3+} + HSO_4^- \rightleftharpoons [TlSO_4]^+ + H^+$$
$$Tl^{3+} + H_2O \rightleftharpoons [TlOH]^{2+} + H^+.$$

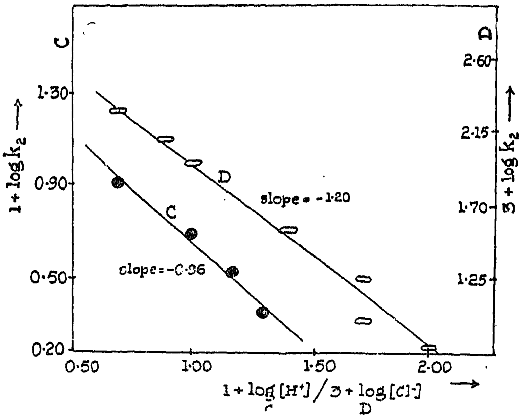


FIG. 2

TABLE I

$[N_2H_4 \cdot H_2SO_4]$ = 0·002093 M; $[H_2SO_4]$ = 2·0 M;
Temp.: 30° C.
[Tl(III)] = 0·02090 M; [NaCl] = 0·005 M

[added salt] (M)	$k_2 \times 10^1$ litre-mole^{-1} sec.$^{-1}$
0·2^a	2·20
0·4^a	3·15
1·0^a	5·79
2·0^a	8·16
0·2^b	2·62
0·4^b	2·64
0·8^b	2·83
1·5^b	2·79

a = Na_2SO_4 *b* = $KHSO_4$

As was mentioned earlier the reaction is considerably retarded by added Cl^- ions. There indeed exists an inverse first-order dependence of the rate on $[Cl^-]$ (Fig. 2, D). This experimental finding is in accord with the following equilibrium:

$$Tl(OH)^{2+} + H^+ + Cl^- \rightleftharpoons [TlCl]^{2+} + H_2O.$$

There is a rapid evolution of nitrogen during the reaction and no ammonia could be detected as the product of oxidation. Our observations thus indicate that Tl(III) oxidises hydrazine sulphate quantitatively to nitrogen and is essentially behaving as a two-electron oxidant.

The reaction exhibits an Arrhenius dependence and has an activation energy of 36·2 k. cals./mole and unusually large entropy of activation

($\Delta S = +58 \cdot 3$ e.u.). Reactions between ions of like charges are known to have such high values of Δ S.[14]

Dept. of Chemistry, V. S. SRINIVASAN.
Vivekananda College, N. VENKATASUBRAMANIAN.*
Mylapore, Madras-4,
December 8, 1969.

---

* To whom all correspondence may be addressed.

1. Kirk and Browne, *J. Am. Chem. Soc.*, 1928, **50**, 337.
2. Higginson, W. C. E., Sutton, P. and Wright, P., *J. Chem. Soc.*, 1953, p. 1380.
3. Cahn, J. W. and Powell, R. E., *J. Am. Chem. Soc.*, 1954, **76**, 2568.
4. Higginson, W. C. E. and Wright, P., *J. Chem. Soc.*, 1955, p. 1551.
5. Pollard, F. H. and Nickless, G., *J. Chroatoy.*, 1960, **4**, 196.
6. Sengupta, K. K. and Chakravarthi, K., *J. Proc. Ind. Chemists (Ind.)*. 1964, **36**, 97.
7. Berka, A., Smolkova, E. and Bocanovski, E., *Z. Anal. Chem.*, 1964, **204**, 87.
8. Francesco Minisci Remogalli and Mirellacecre, *Gazz. Chim. Ital.*, 1965, **95**, 751; *Chem. Abstr.*, 1966, **65**, 3693 (*h*).
9. Simone Ostrowetsky and Danielle Brinon, *Compt. Rend.*, Series C, 1966, **263**, 406.
10. Drotschman, C., *Chem. Weekblad.*, 1965, **49**, 581; *Chem. Abstr.*, 1966, **64**, 7661 (*f*).
11. Hodges, R. J. and Pickering, W. F., *Aust. J. Chem.*, 1966, **19**, 981.
12. Jijee, K. and Santappa, M., *Proc. Ind. Acad. Sci.*, 1969, **69**, 117.
13. Srinivasan, V. S. and Venkatasubramanian, N., *Ind. J. Chem.* (accepted for publication).
14. Frost, A. A. and Pearson, R. G., *Kinetics and Mechanism*, John Wiley and Sons, N.Y., 1963.

VITELLOGENESIS IN SOME GALL MIDGES*

THE origin, fate, composition and function of most ooplasmic particles in many insects remain unknown.[1] Practically nothing is known about vitellogenesis in gall midges[2]; the only information available relates to trophic connections in pædogenetic forms.[3]

In the studies on reproductive biology of gall midges, we have investigated the differentiation of the ovary and vitellogenesis in *Pachydiplosis oryzæ* and *Rubsaamenia artocarpi*. In both insects the differentiation of the ovary commences at the pupal stage when the eggs become well defined and invested by follicles. The egg nucleus, feebly discernible with a tangled mass of faintly Feulgen-positive threads, lie at one end of the egg, while at its opposite pole lies a small, strongly Feulgen-positive cluster of nurse cell nuclei. Each nurse nucleus shows initially a halo bounded by the nuclear membrane and small nucleoli, Towards the second day of pupation, the nurse cell nuclei get organised into a multinucleate mass, each nucleus enlarged and the intensely Feulgen-positive material increased, suggestive of a polyploid nucleus. In this stage the nuclei show faintly marked regions being sites of nucleoli; these appear as well-marked acidophil bodies in general staining. The nucleoli have increased in number. There is often a coalescence of nuclei, well marked in *Pachydiplosis*, but in *Rübsaamenia* the nuclei show clear, vesicular space between nuclear membrane and chromatin. Near the time of emergence of the adult, a rapid spurt of growth occurs in the size of the egg. The multinucleate mass seems to merge into the cytoplasm: in *Rübsaamenia* the nuclear membranes disappear followed by a concomitant increase in cytoplasmic globules and granules, while in *Pachydiplosis* a shrinkage of the nuclear mass accompanied by accumulation of material in ooplasm becomes apparent. In *Pachydiplosis* this is most marked within the first 5 to 10 hours of emergence but poorly defined during 1 to 5 hours. The eggs become filled with yolk growing to a size of 0·7 mm. in length and 0·13 mm. across. The pupal period is only 4 days.

In the pupal instar the corpora allata are generally known to be inactive, not producing juvenile hormone, to facilitate metamorphosis. Soon after eclosion of the adult, the corpora allata resume their activity to exercise the gonadotrophic functions.[4] The maximal size of the corpora allata in *Pachydiplosis* is seen after 4 hours of emergence; they are only two-thirds this size in pupal instar. Decapitated female pupæ emerge into adults but the egg growth fails to occur, even if it is done a few minutes before eclosion.

These findings suggest that in *Pachydiplosis* and in *Rübsaamenia*, ovarian growth gets initiated in the absence of the juvenile hormone, that yolk deposition gets completed only under the influence of the reactivated corpora allata in the initial hours of adult life and that nurse cells entering into the oocytes aid in elaborating yolk after their turning polyploid and inducing synthesis. That the corpora allata increase in size in the adult midge has already been recorded in *Sitodiplosis*.[5] The role of polyploid nurse nuclei in elaboration of yolk has been studied in *Drosophila*[6]; increase in nucleolar content of nurse cell nuclei, in relation to oogenesis recorded here in gall midges, has been observed also in *Calliphora*[7] and *Musca*.[8]

Dept. of Zoology, K. K. NAYAR.
University of Kerala,
Trivandrum, *November* 27, 1969.

---

* Study supported by a grant from the Ford Foundation.

1. King, R. C., *Symp. Roy. ent. Soc. London*, 1964, **2**, 13.
2. Mathuszewski, B., *In Litt.*, 1967.
3. Ivanova-Kasas, O. M., *Acta Biol. Acad. Sci. Hungaricae*, 1965, **16**, 1.
4. Gilbert, L. I., *Physiology of Insecta*, 1964, **1**, 149.
5. Nayar, K. K., *Proc. Zool. Soc.* 1965, **9**, 13.
6. King, R. C., Rubinson, A. C. and Smith, R. F., *Growth*, 1956, **20**, 121.
7. Ribbert, D. and Bier, K., *Chromosoma*, 1969, **27**, 178.
8. Engels, W. and Ribbert, D., *Experientia*, 1969, **25**, 805.

EFFECT OF EYESTALK REMOVAL ON THE RATE OF OXYGEN CONSUMPTION IN *CARIDINA RAJADHARI* BOUVIER (DECAPODA ATYIDAE)

SCUDAMORE[1] demonstrated that the removal of the eyestalks in *Cambarus* resulted in increased oxygen consumption and further injection of eyestalk extract decreased the respiratory rate in the destalked animals. Later Edwards,[2] Bliss[3] and Frost *et al.*[4] reported the role of eyestalk hormone in oxygen requirement in decapod crustaceans. On the other hand, Teyan *et al.*[5] showed that if the eyestalk stubs were cauterised, the level of oxygen consumption in operated fiddler crabs remained the same as in controls or decreased. In view of these contradictory findings, the present study was initiated to determine the effect of eyestalk ablation on the rate of oxygen consumption in the freshwater *Caridina rajadhari*.

Four batches of five animals each were taken. Eyestalks were ablated and the stubs were cauterised in animals of the batches I and II. Batch III served as intact control. A small portion from the base of the eyestalk was removed from the animals belonging to batch IV, and this batch served as the sham-operated control. Of the two destalked batches, batch I served as destalked experimental and batch II received eyestalk extract injection. Ten eyestalks were triturated, suspended in 0·15 ml. of distilled water and centrifuged. 0·02 ml. of the supernatant fluid was injected to each animal of batch II.

The rate of oxygen consumption was measured after twenty-four hours of eyestalk removal for the animals belonging to the batches I and II. Oxygen consumption was measured by Winkler's method.[6] The quantity of oxygen consumed was calculated in relation to unit wet weight of the animals and the values thus obtained were expressed as rate of oxygen consumption in ml. per hour per gm. wet weight. The room temperature during the course of these experiments varied between 25–27° C. The results are presented in Table I.

TABLE I

Oxygen consumption of Caridina rajadhari *Bouvier (ml./hr./gm.) in relation to eyestalk ablation*

Batches	Treatment	No. of animals	Mean weight of the animals in gm.	Mean value of oxygen consumed ± S.D. (ml /hr./gm.)
I	Both eyestalks removed	5	1·060	0·4623 ±0·0387
II	Both eyestalks removed and injected eyestalk extract	5	1·155	0·3333 ±0·0265
III	Intact control ..	5	1·215	0·3025 ±0·0232
IV	Sham-operated ..	5	1·055	0·3318 ±0·0324

The oxygen consumption of the destalked *Caridina rajadhari* is considerably increased when compared with that of the intact and sham-operated controls. In batch II, injection of eyestalk extract in destalked animals results in restoration of the rate of the oxygen consumption to a greater extent although it is slightly higher than those in intact and sham-operated controls. The restoration in the rate noticed to a great extent in the eyestalkless animals after injection of eyestalk extract suggests the possibility of the eyestalk containing a factor which regulates the rate of oxygen consumption.

The observation on the increase in oxygen consumption after eyestalk removal is in agreement with the findings reported earlier by Scudamore.[1] However, the findings made by Teyan *et al.*[5] are at variance.

I am grateful to Dr. R. Nagabhushanam for his guidance and to Prof. S. Mehdi Ali for kindly providing facilities to carry out the work, I thank the Council of Scientific and Industrial Research for the award of a Senior Research Fellowship.

Department of Zoology, B. CHINNAYYA.
Marathwada University,
Aurangabad, *December* 15, 1969.

---

1. Scudamore, H. H., *Physiol. Zool.*, 1947, **20**, 187.
2. Edwards G. A., *Physiol. Comp. et Oecol.*, 1950, **2**, 34.
3. Bliss, D. E., *Biol. Bull.*, 1953, **104**, 275.
4. Frost, R., Saloum, R. and Kleinholz, L. H., *Anat. Record.*, 1951, **111**, 572.
5. Teyan, F. J., Sudak, F. N. and Claff, C. L., *Biol. Bull.*, 1959, **117**, 429.
6. Welsh, J. H. and Smith, R. I., *Laboratory Exercises in Invertebrate Physiology*, Burgess Publishing Company, 1960.

POLYPORUS CALCUTTENSIS AND ITS IMPERFECT FORM

THERE are very few polypores which produce imperfect forms in nature to be known as *Ptychogaster*. Bose[1] in the year 1925 described a new species of polypore from Calcutta and named it *Polyporus calcuttensis*. Later[2] he also reported its *Ptychogaster* stage and by cultural studies, he was able to establish their mutual relationship. Since these first reports the review of literature does not show any other work on this fungus except that of Pegler[3] (1967).

Recently, during routine field trips, the author collected a sporophore of *P. calcuttensis* which was found growing on a dead branch of a banyan tree with a *Ptychogaster* on its upper surface. Several other collections of this *Ptychogaster* were also made on different occasions. Microscopical study with all these sporophores shows the great similarities existing between these perfect and imperfect forms of this fungus.

As the descriptions given by Bose are not so detailed, a fuller description of this fungus in both of its stages is presented here to enable identification of this rare species in the field.

Polyporus calcuttensis

Sporophore.—Sessile, applanate, 30 × 13 × 2·5 cm. in size, somewhat soft when fresh, becoming hard but light in weight on drying; *Margin*: moderately thick, obtuse, glabrous, somewhat undulate and yellowish-brown; *Upper surface*: yellowish-brown, smooth and glossy when young showing broad zones more marked towards the margin, turning snuff-brown, rough and rugulose with age; *Context*: dark brown, silky, fibrous, faintly zoned, 1·5 cm. thick at the base; *Hymenial surface*: smooth, shiny with a greenish-grey lustre in fresh condition becoming yellow-brown when dried, extended upto a very narrow sterile margin; *Pores*: round, small, 3–5 per mm.; *Pore tubes*: light brown, about 1 cm. long at the base; *Basidia*: clavate, tetrasterigmatic, 12–22·5 × 3–7·5 μ; *Basidiospores*: smooth, oval to short elliptic, hyaline and thin-walled when young, slightly thick-walled and yellowish at maturity, 6–7·5 × 4·5–6 μ.

Hyphal system dimitic with setoid skeletal hyphæ and simple septate generative hyphæ of two aspects: (*i*) hyaline, thin-walled, flexuous with protoplasmic contents, freely branched, 2·2–4 μ wide; (*ii*) yellow-brown, thin- to slightly thick-walled, thickening being more pronounced at septa, mostly empty, some with scanty contents, more straight, less frequently branched, 4–8 μ wide. *Setoid skeletal hyphæ*: dark brown, thick-walled, usually unbranched, aseptate with pointed apex, 160–320 μ long and 6–12 μ wide, distributed in all the regions of the sporophore being more profuse on the uppermost surface of the context where they form trichoderms in younger stage of the pileus and crustiform cortex in its older stage; true setæ lacking in the hymenial layer but occasionally setoid skeletal hyphæ penetrate into the pore mouth; highly thick-walled, dark brown, round to oval chlamydospores, 9–17 × 9–12 μ, abundant on the pilear surface; conidia resembling basidiospores in size and appearance are produced by generative hyphæ at the surface layer of the pileus.

Ptychogaster

Sporophore: always growing as irregular, globular, soft mass, golden-yellow, smooth and velvety to touch, becoming dark brown and somewhat powdery with age, very light in weight and easily separable from the host; internally brown showing fine concentric zones in the fibrous tissue towards the younger region of growth and dark brown, homogeneous, compact, powdery mass in the older part.

Hyphal system dimitic consisting of generative hyphæ and setoid skeletal hyphæ, better studied in the fibrous tissue of the younger part; older powdery mass contains besides hyphæ numerous thick-walled, loose chlamydospores. Hyphæ and chlamydospores are similar in character to the hyphæ and chlamydospores found in perfect form.

The author expresses her sincere thanks to Dr. K. Bhattacharya, Vice-Chancellor, for permission to work in the Institute, and to

Dr. H. L. Sarkar, Head of the Department of Zoology, for providing necessary facilities.

Department of Zoology, ANJALI ROY.
Visva Bharati University,
Santiniketan,
West Bengal, *November* 30, 1969.

1. Bose, S. R., *Ann. Mycol* 1925, 22 (1 & 2), 179.
2. —, *J. Lin. Soc.*, 1930, 48, 417.
3. Pegler, D. N., *Kew. Bull.*, 1967, 21, 39.

CLASSIFICATION OF CULTIVATED VARIETIES OF GROUNDNUT

CULTIVATED varieties of groundnut are generally classified, according to their growth habit, as (1) erect, (2) bunch, (3) semi-bunch or semi-spreading, (4) spreading, (5) trailing. This system has been suggested by John, Venkatnarayana and Seshadri[1] and several others, in India, which is still being followed. On the contrary, Gregory *et al.*,[2] in the United States of America classified the bunch types into Valencia, Spanish and Virginia, on the basis of flowering habit. In Spanish types, the flowers are produced only in the axils of lower leaves, whereas they are borne more or less throughout the main stem in Valencia. No flowers are produced on the main axis of Virginia bunch types, as in the case of spreading forms. A revised system of the above was put forth by Bunting[3,4] and Smarth[5] which shows two main sections, *viz.*, (*i*) sequentially branched (subspecies *fastigiata*) and (*ii*) alternate branched (subspecies *hypogœa*). These two groups are distinguished from each other in the distribution of vegetative branches and inflorescences in the axils of leaves of the main axis as well as on the branches. The former includes both Valencia and Spanish types, and the latter includes the bunch and semi-spreading forms of Virginia and all the spreading varieties.

In the present study, 300 elite types of groundnut (both exotic introductions and local selections) were classified and catalogued on the basis of their similarities and contrasting characters, and it was observed that the two groups are distinguished from each other in a wide variety of other characters which are unrelated to each other, as shown in Table I.

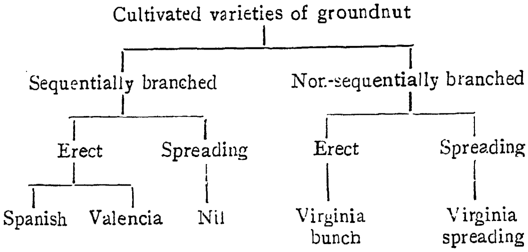
TABLE I

Characters distinction of sequentially branched and alternate branched groups of cultivated varieties of groundnut

S. No.	Sequentially branched	Alternate branched
1	Habit upright bunch	Habit bunch, semi-bunch, semi-spreading, or spreading
2	Light green foliage	Green or dark green foliage
3	Susceptible to *Cercospora* leaf spots, bud-rot virus and other diseases	Field tolerance or resistance found for *Cercospora* leaf spcts, bud-rot virus and other diseases
4	Flowers noticed in the axils of leaves of the main stem	Flowers absent in the axils of leaves of main stem
5	Early flowering and maturity	Late flowering and maturity
6	Secondary or tertiary branches few or uncommon	Secondary and tertiary branches plenty
7	Plants moderately branched, consisting of four or six main laterals, usually of approximately equal length	Plants profusely branched with main laterals of unequal length
8	Most of the bottom leaves dry up at the time of harvest	Practically almost all the leaves remain green till harvest period
9	Moderate or poor nodulation	Rich nodulation
10	Fruiting habit compact or semi-compact	Fruiting habit diffuse
11	Pods generally found only at lower nodes	Pods extend to upper nodes as well
12	Seeds not dormant	Seeds dormant
13	Seedcoat stretched and smooth	Seedcoat folded and rugged
14	Shelling percentage usually good	Shelling percentage poor
15	Maturity percentage high	Maturity percentage low
16	Seeds compact in mature pods	Seeds loosely arranged in mature pods
17	Seedcoat bitter in taste	Seedcoat palatable with almond-like flavour

It is quite apparent from Table I that the Virginia bunch or semi-spreading varieties and spreading types share several characters in common. Therefore, all these types can be put together into one group, rather than to associate Virginia bunch, semi-bunch or semi-spreading forms with other bunch types like Spanish and Valencia.

All the attempts made hitherto to transfer economic characters such as dormancy, resistance to *Cercospora* leaf spots, etc., from alternate branched types to sequentially branched varieties or *vice versa*, met with little or no success. This provides further evidence to classify the cultivated varieties of groundnut into alternate or sequentially branched types. In short, the following system of main classification is suggested :



It is a common observation that the growth habit of even an ordinary bunch type such as TMV.$_2$ is much influenced by the environment, particularly season, which looks like erect bunch during *kharif* and semi-spreading in *rabi* sowing, and as such, it serves little purpose as a taxonomic unit, and at the best, it is useful only for agronomic classification. Considerable variation is, however, found within the individual groups of Spanish bunch, Virginia bunch and spreading forms for pod and seed characters, such as oil content, pod number, seed size, number of seeds per pod, etc., and hence hybridization may be limited to favourable types among these groups for immediate improvement of yield and oil content in groundnut.

The authors are thankful to Dr. M. S. Swaminathan, Director of the Indian Agicultural Research Institute, New Delhi, for suggesting the problem and keen interest throughout the course of the work.

Regional Res. Station, (I.A.R.I.),
Rajendranagar,
Hyderabad-30, *November* 29, 1969.

V. S. Sarma.
R. Vijay Kumar.
L. G. Kulkarni.

---

1. John, C. M., Venkatnarayana, G. and Seshadri, C. R., *Ind. Jour. Agri. Sci.*, 1955, **24**, 159.
2. Gregori, W. C., Smith Ben, W. and Yarborough, *Morphology, Genetics and Breeding, The Unpredictable Legume* (A Symposium published by the National Fertilizers Association, Washington, D.C., 1951, p. 28.
3. Bunting. A. H., *Emp. J. Exp. Agric.*, 1955, **23**, 158.
4. —, *Ibid.*, 1958, **26**, 254.
5. Smarth, J., *Ibid.*, 1961, **29**, 153.

OIL-PALM (*ELAEIS GUINEENSIS* JACQ.), A NATURAL HOST OF ROOT (WILT) DISEASE PATHOGEN OF COCONUT

One year old seedlings of oil-palm (*Elæis guineensis* Jacq.) were planted in the research farm of this station where the incidence of root (wilt) disease is very high to observe their reaction to the disease. The seedlings were recently reported to colonise the lace wing bug (*Stephanitis typicus* Dist.), the vector of the root (wilt) disease of coconut.[1] A large number of seedlings began to exhibit pronounced flaccidity of leaflets resembling that of root (wilt) infected coconut trees during the course of this year. Observations on symptoms and diagnostic tests on the cowpea indicator host were carried out with the seedlings. The details are presented.

Oil-palm seedlings were raised from seeds variety Deli × P received from the Chemara Plantations, Layang Layang, Malaya, in 1963. Fifty-nine seedlings were transplanted in the research farm with root (wilt) diseased coconut trees all round in 1964. Twenty-nine seedlings had already exhibited symptoms of flaccidity and drooping of leaflets (Fig. 1) by 1969. The leaves of the affected palms were slightly paler than normal. Infection trials with all the 59 seedlings were carried out on cowpea (*Vigna sinensis* Endl.) indicator host for the root (wilt) disease pathogen of coconuts.[2] Adults of *S. typicus* were used for transmission tests by feeding for 24 hours on young green leaves of test material and then liberating them on healthy test plants. Diagnostic symptoms of necrosis and distortion of the first trifoliate leaves were produced with 14 palms out of 29 showing symptoms of disease. It was also

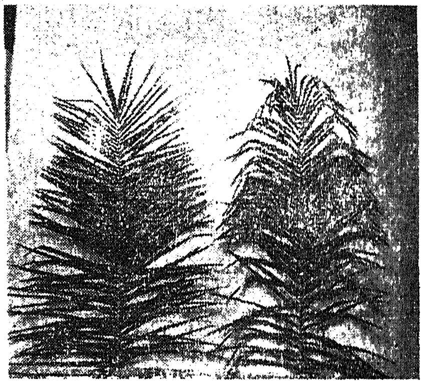


FIG. 1. Single leaf of healthy (left) and diseased (right) oil-palm.

observed that a large number of oil-palm seedlings got diseased at or about the commencement of flowering.

The symptoms of flaccidity and drooping of leaflets in oil-palm seedlings together with slight paling, transmission of the disease through *S. typicus* and production of diagnostic symptom on cowpea seedlings are indicative of root (wilt) disease of coconuts infecting the oil-palms in nature.

The susceptibility of the oil-palm to the root (wilt) disease of coconut in nature is of a special significance since it is being introduced in Kerala as a promising commercial crop.

Central Coconut Res. Station,
Kayangulam,
November 12, 1969.

P. SHANTA.
N. GOPINATHAN PILLAI.
S. B. LAL.

---

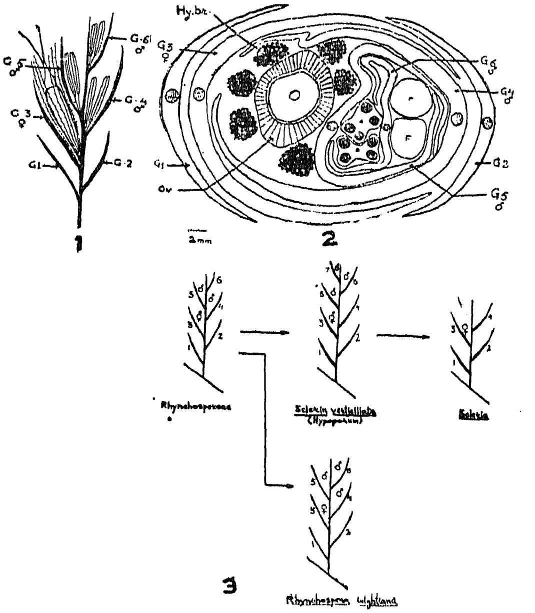
1. Thomas Joseph and Shanta, P., *Curr. Sci.*, 1968, **37**, 619.
2. Shanta, P. and Menon, K. P. V., *Virology*, 1960, **12**, 307.

RHYNCHOSPORA WIGHTIANA STEUD.—A UNISEXUAL PLANT

Rhynchospora Vahl., a genus belonging to the tribe Rhynchosporeæ of the Cyperaceæ, comprises about 200 species distributed in the warmer regions of the world (Lawrence[3]). Most floras report that this genus has bisexual flowers. Recently, the authors collected *R. wightiana* Steud. near Ramtek, on Ramtek-Khindsi Road, about 50 Km. from Nagpur. The plant is being investigated embryologically. During this investigation it was noticed that the local species does not possess any bisexual flower as reported in the floras but shows only unisexual ones in its spikelets and the speries is monœcious. The following are the exomorphic observations.

The plant is a small, tufted herb, 8 to 12 inches high, having many, long and narrow leaves. Spikelets are borne in dense, rusty brown or golden-coloured heads. They are linear and have a condensed axis with six distichously arranged glumes. The lower two glumes are empty. Slightly above, in the axil of the third glume, is present a female flower surrounded by six hypogynous bristles. The subsequent glumes develop male flowers in their axils represented by a pair of functional stamens (Fig. 1). Thus each spikelet shows a female flower in the axil of the third glume, the lower two glumes being sterile. The male flowers are developed in all the upper succeeding glumes. The separation of the sexes in the spikelets is quite obvious in transection (Fig. 2). Similar observations have been recorded recently by Shah and Suryanarayana[4] as also from Malaysia by Kern.[1]

While discussing delimitations and interrelationships of the subdivisions of the Cyperaceæ, Koyama[2] divided the family into six tribes under four subfamilies, *viz.*, Mapanoideæ, Scirpoideæ, Rhynchosporoideæ and Caricoideæ. In the subfamily Rhynchosporoideæ are included two tribes Rhynchosporeæ and Sclerieæ. He believes that the Scleroid type of spikelets, which are unisexual, are more reduced—a condition descended from the Rhynchosporoid type where at least one flower of the spikelet is bisexual. This contention is based on the presence of androgynous spikelets in the section *Hypoporum* of *Scleria*. This intermediate condition found in some members of the Sclerieæ parallels that in *R. wightiana* with the sole difference that the female flower here is borne in the axil of the third glume (Fig. 3). Thus the tendency towards the "reduction of floral components", which shows the phylogenetic trend in reduction from Rhynchosproid to Scleroid type,



FIGS. 1–3. *Rhynchostora wightiana* Steud. Fig. 1. Spikelet; Fig. 2. Same in transverse section. Fig. 3. Schematic representation to show evolutionary tendency from Rhynchosporoid type of spikelet to Scleroid type. (*G*. Glume; *Hy. br.*, Hypogynous bristle; *Ov.*, Ovary; *F.*, Filament.)

seems to have set in not only in some species of *Scleria* but at the lower level in the genus *Rhynchospora* as seen in *R. wightiana.*

The contention of Koyama[2] that the Scleroid type of spikelets are reduced and descended from the Rhynchosporoid seems justified.

We are thankful to Prof. L. B. Kajale for going through the manuscript and facilities.

Department of Botany, M. D. PADHYE.
Nagpur University, A. G. UNTAWALE.
Nagpur, *December* 13, 1969.

---

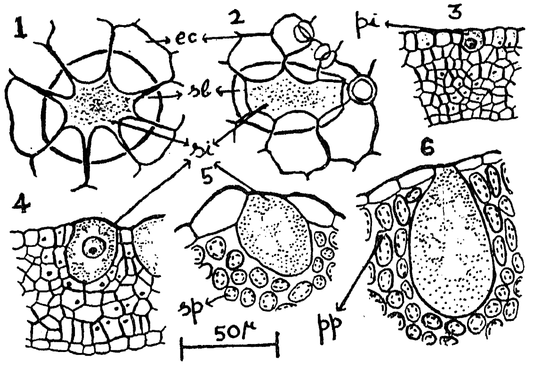
1. Kern, J. H., *Science*, 1962, **19**, 141.
2. Koyama, T., *J. Fac. Sci. Univ. Tokyo*, 1961, **8**, 37.
3. Lawrence, G. H. M., *Taxonomy of Vascular Plants*, 1963.
4. Shah, G. L. and Suryanarayana, B, *Curr. Sci.*, 1967, **36** 157.

A NOTE ON THE SECRETORY IDIOBLASTS OF THE FOLIAR EPIDERMIS OF *CROTALARIA RETUSA*, L.

THE presence of idioblasts in foliar epidermis is reported infrequently in the literature, though their possible taxonomic value has often been pointed out.[1,2] The idioblastic cell-sacs of *Cleome aspera*, Koen. Ex DC. is an interesting recent investigation.[3] Idioblasts of specifically secretory nature have been considered to be useful in the classification of the family, Cruciferæ[4] and the identification of the species of the genus, *Aristolochia*.[5] Metcalfe and Chalk[4] reported secretory idioblasts in most of the genera of the subfamily, Papilionatæ, but the entire large genus of *Crotalaria* does not find any mention by them. The present note deals with the structure and development of the secretory idioblasts in the leaves of *Crotalaria retusa*, L., a species well known for its pyrrolizidine alkaloids[6] and medicinal uses.[7]

The idioblasts appear as circular to oblong structures on both the upper and lower epidermis under low magnification (100 ×). They are unicellular, as evident from their ontogeny and hence homologous to other epidermal idioblasts.[4] On the upper surface, they are very closely arranged, frequently forming contiguous chains of 3–5 idioblasts, while they are less dense on the lower surface. A distinct radiating circlet of inwardly bulging large cells around the idioblast (Fig. 1) characterises the latter's appearance on the upper surface, while such a feature is less prominent on the lower surface (Fig. 2). At maturity the idioblast of upper surface is a flask-shaped cavity (similar to that of *Machærium*[4]) with its long axis perpendicular to the epidermal surface (Fig. 6) and penetrating very deep, often reaching the vascular strands. The lower ones are neither flask-shaped nor so deeply penetrating (Fig. 5).

Ontogenetically, the idioblasts arise from the protoderm initials without any further division. These initials can be easily distinguished in transections of even very young leaves, by their large size, dense cytoplasm and prominent nucleus (Fig. 3). As they develop, they intrude the mesophyll even beyond the palisade tissue, become flask-shaped and also develop richly granular contents. These contents turn very dark when treated with hæmatoxylin indicating their tanniniferous nature. The nucleus found in the idioblasts at various intermediate stages is much larger than those of the other epidermal cells (Fig. 4). This may point to its secretory nature as is the case with the trichome of *Trichosanthes palmata*.[8] Such idioblasts are observed in the other species like *C. juncea*, L., *C. mysorensis*, Roth., *C. paniculata*, Willd., and *C. striata*, DC. But they are not as prominent and frequent as those of *Crotalaria retusa*, L.



FIGS. 1–6. Figs. 1–2. Surface view of the secretory idioblasts; Fig. 1. Upper epidermis. Fig. 2. Lower epidermis. Figs. 3–6. Idioblasts in transections; Figs. 3–4 Developmental stages. Fig. 5. Mature idioblast of lower epidermis. Fig. 6. Same of upper epidermis. [*ec*, epidermal cell; *pi*, protoderm initial (idioblast); *pp*, palisade tissue; *sb*, swollen base of the idioblast; *si*, seceretory idioblast; *sp*, spongy parenchyma.]

Dept. of Biology, K. H. KRISHNAMURTHY.
Jawaharlal Institute of B. KANNABIRAN.
Post-Graduate Medical
Education and Research,
Pondicherry-6, *December* 10, 1969.

---

1. Jalan, S., *Curr. Sci.*, 1965, **34,** 527.
2. Bloch, R., *Am. J. Bot.*, 1946, **33,** 544.
3. Rajagopal, T. and Ramayya, N., *Curr. Sci.*, 1968, **37,** 260.
4. Metcalfe, C. R. and Chalk, L., *Anatomy of the Dicotyledons* (Rep. ed.), Clarendon Press, Oxford, 1957, Vol. 1.
5. Solereder, H., *Systematic Anatomy of the Dicotyledons*, Engl. Trans., Clarendon Press, Oxford, 1908.
6. Bull, L. B., Culvenor, C. C. J. and Dick, A. T., *The Pyrrolizidine Alkaloids*, North Holland Pub. Co., Amsterdam, 1968.
7. Nadkarni, K. M., *Indian Materia Medica*, Popular Book Depot, Bombay, 1954, Vol, 1.
8. Rangasami Ayyangar, K., *Proc. 56th Ind. Sci. Cong., Abstracts*, 1969, p. 381.

BEHAVIOUR OF SANNHEMP MOSAIC VIRUS IN SANNHEMP (*CROTALARIA JUNCEA* L.) AND TOBACCO (*NICOTIANA TABACUM* VAR. WHITE BURLEY)

BAWDEN[1,2] reported reversible host-induced changes brought about by certain strains of tobacco mosaic virus (TMV) from leguminous plants. During the course of studies on Sannhemp mosaic virus (SMV) in our laboratory similar phenomenon was observed. Sannhemp mosaic virus, a strain of TMV[3] produces systemic mosaic symptoms when inoculated with infective sap on sannhemp and tobacco var. White Burley but induces local lesions on guar, *Cyamopsis tetragonoloba* (L.) Taub,[3,5] *Nicotiana glutinosa* and *Chenopodium amaranticolor*.[4] It was, however, observed that the ability to induce local lesions on guar was lost if the virus was multiplied on tobacco var. White Burley and could be restored by inoculating on sannhemp plants.

When SMV was multiplied in sannhemp, the inoculum constantly produced countable necrotic local lesions on guar. However, when the virus from this source was multiplied on tobacco, only the inoculum from first tobacco plants, infected with the virus from sannhemp, induced local lesions on guar. The inoculum taken from tobacco plants on which the virus was subsequently multiplied from the first inoculated tobacco plants failed to give local lesions on guar although it continued to produce local lesions on *N. glutinosa* and *C. amaranticolor*. It was also observed that the local lesions on *C. amaranticolor* were rather diffused and formed 24 hours later (after 72–96 hours) in case of inoculum from sannhemp than in case of inoculum from tobacco which induced lesions within 48–72 hours of inoculation.[4]

In order to determine if the ability to produce local lesions on guar could be restored by inoculating the virus back to sannhemp, the inoculum from tobacco was inoculated on sannhemp plants on which it induced mosaic symptoms after a long incubation period of 21–25 days. The inoculum from these sannhemp plants produced characteristic local lesions on guar plants. The SMV normally produces systemic mosaic symptoms within 7–10 days when inoculated from sannhemp to sannhemp or tobacco to tobacco but in cross-inoculations from sannhemp to tobacco or tobacco to sannhemp, the incubation period is prolonged to about 3–4 weeks.

Effect of High Temperatures on Symptoms Induced on Sannhemp.—The sannhemp mosaic virus when inoculated on sannhemp plants normally does not produce any symptoms on the inoculated leaves. It was, however, observed that when the inoculations of the virus were made at high temperatures during summer (above 106° F.) the infective sap produced necrotic local lesions on the inoculated leaves of sannhemp plants. The local lesions appeared on the third day of inoculation in the form of small brown spots which turned necrotic and increased in diameter within two days of their appearance (Fig. 1). This was followed by systemic mosaic symptoms characteristic of SMV on the young leaves with 7–10 days of inoculation. The infective sap taken from such plants produced local lesions on guar,

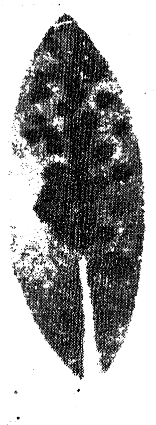


FIG. 1. Local lesions produced by sannhemp mosaic virus on inoculated leaf of sannhemp at high temperature.

seems to have set in not only in some species of *Scleria* but at the lower level in the genus *Rhynchospora* as seen in *R. wightiana*.

The contention of Koyama[2] that the Scleroid type of spikelets are reduced and descended from the Rhynchosporoid seems justified.

We are thankful to Prof. L. B. Kajale for going through the manuscript and facilities.

Department of Botany, M. D. PADHYE.
Nagpur University, A. G. UNTAWALE.
Nagpur, *December* 13, 1969.

---

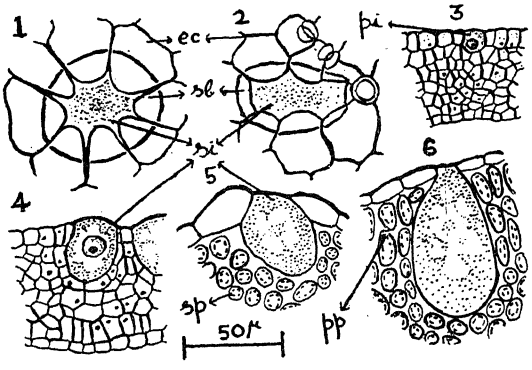
1. Kern, J. H., *Science*, 1962, **19**, **141**.
2. Koyama, T., *J. Fac. Sci. Univ. Tokyo*, 1961, **8**, **37**.
3. Lawrence, G. H. M., *Taxonomy of Vascular Plants*, 1963.
4. Shah, G. L. and Suryanarayana, B, *Curr. Sci.*, 1967, **36**. 157.

A NOTE ON THE SECRETORY IDIOBLASTS OF THE FOLIAR EPIDERMIS OF *CROTALARIA RETUSA*, L.

THE presence of idioblasts in foliar epidermis is reported infrequently in the literature, though their possible taxonomic value has often been pointed out.[1,2] The idioblastic cell-sacs of *Cleome aspera*, Koen. Ex DC. is an interesting recent investigation.[3] Idioblasts of specifically secretory nature have been considered to be useful in the classification of the family, Cruciferæ[4] and the identification of the species of the genus, *Aristolochia*.[5] Metcalfe and Chalk[4] reported secretory idioblasts in most of the genera of the subfamily, Papilionatæ, but the entire large genus of *Crotalaria* does not find any mention by them. The present note deals with the structure and development of the secretory idioblasts in the leaves of *Crotalaria retusa*, L., a species well known for its pyrrolizidine alkaloids[6] and medicinal uses.[7]

The idioblasts appear as circular to oblong structures on both the upper and lower epidermis under low magnification (100 ×). They are unicellular, as evident from their ontogeny and hence homologous to other epidermal idioblasts.[4] On the upper surface, they are very closely arranged, frequently forming contiguous chains of 3–5 idioblasts, while they are less dense on the lower surface. A distinct radiating circlet of inwardly bulging large cells around the idioblast (Fig. 1) characterises the latter's appearance on the upper surface, while such a feature is less prominent on the lower surface (Fig. 2). At maturity the idioblast of upper surface is a flask-shaped cavity (similar to that of *Machœrium*[4]) with its long axis perpendicular to the epidermal surface (Fig. 6) and penetrating very deep, often reaching the vascular strands. The lower ones are neither flask-shaped nor so deeply penetrating (Fig. 5).

Ontogenetically, the idioblasts arise from the protoderm initials without any further division. These initials can be easily distinguished in transections of even very young leaves, by their large size, dense cytoplasm and prominent nucleus (Fig. 3). As they develop, they intrude the mesophyll even beyond the palisade tissue, become flask-shaped and also develop richly granular contents. These contents turn very dark when treated with hæmatoxylin indicating their tanniniferous nature. The nucleus found in the idioblasts at various intermediate stages is much larger than those of the other epidermal cells (Fig. 4). This may point to its secretory nature as is the case with the trichome of *Trichosanthes palmata*.[8] Such idioblasts are observed in the other species like *C. juncea*, L., *C. mysorensis*, Roth., *C. paniculata*, Willd., and *C. striata*, DC. But they are not as prominent and frequent as those of *Crotalaria retusa*, L.



FIGS. 1–6. Figs. 1–2. Surface view of the secretory idioblasts; Fig. 1. Upper epidermis. Fig. 2. Lower epidermis. Figs. 3–6. Idioblasts in transections; Figs. 3–4 Developmental stages. Fig. 5. Mature idioblast of lower epidermis. Fig. 6. Same of upper epidermis. [*ec*, epidermal cell; *pi*, protoderm initial (idioblast); *pp*, palisade tissue; *sb*, swollen base of the idioblast; *si*, seceretory idioblast; *sp*, spongy parenchyma.]

Dept. of Biology, K. H. KRISHNAMURTHY.
Jawaharlal Institute of B. KANNABIRAN.
Post-Graduate Medical
Education and Research,
Pondicherry-6, *December* 10, 1969.

---

1. Jalan, S., *Curr. Sci.*, 1965, **34**, 527.
2. Bloch, R., *Am. J. Bot.*, 1946, **33**, 544.
3. Rajagopal, T. and Ramayya, N., *Curr. Sci.*, 1968, **37**, 260.
4. Metcalfe, C. R. and Chalk, L., *Anatomy of the Dicotyledons* (Rep. ed.), Clarendon Press, Oxford, 1957, Vol. 1.
5. Solereder, H., *Systematic Anatomy of the Dicotyledons*, Engl. Trans., Clarendon Press, Oxford, 1908.
6. Bull, L. B., Culvenor, C. C. J. and Dick, A. T., *The Pyrrolizidine Alkaloids*, North Holland Pub. Co., Amsterdam, 1968.
7. Nadkarni, K. M., *Indian Materia Medica*, Popular Book Depot, Bombay, 1954, Vol, **1**.
8. Rangasami Ayyangar, K., *Proc. 56th Ind. Sci. Cong.*, *Abstracts*, 1969, p. 381.

BEHAVIOUR OF SANNHEMP MOSAIC VIRUS IN SANNHEMP (*CROTALARIA JUNCEA* L.) AND TOBACCO (*NICOTIANA TABACUM* VAR. WHITE BURLEY)

BAWDEN[1,2] reported reversible host-induced changes brought about by certain strains of tobacco mosaic virus (TMV) from leguminous plants. During the course of studies on Sannhemp mosaic virus (SMV) in our laboratory similar phenomenon was observed. Sannhemp mosaic virus, a strain of TMV[3] produces systemic mosaic symptoms when inoculated with infective sap on sannhemp and tobacco var. White Burley but induces local lesions on guar, *Cyamopsis tetragonoloba* (L.) Taub,[3,5] *Nicotiana glutinosa* and *Chenopodium amaranticolor*.[4] It was, however, observed that the ability to induce local lesions on guar was lost if the virus was multiplied on tobacco var. White Burley and could be restored by inoculating on sannhemp plants.

When SMV was multiplied in sannhemp, the inoculum constantly produced countable necrotic local lesions on guar. However, when the virus from this source was multiplied on tobacco, only the inoculum from first tobacco plants, infected with the virus from sannhemp, induced local lesions on guar. The inoculum taken from tobacco plants on which the virus was subsequently multiplied from the first inoculated tobacco plants failed to give local lesions on guar although it continued to produce local lesions on *N. glutinosa* and *C. amaranticolor*. It was also observed that the local lesions on *C. amaranticolor* were rather diffused and formed 24 hours later (after 72–96 hours) in case of inoculum from sannhemp than in case of inoculum from tobacco which induced lesions within 48–72 hours of inoculation.[4]

In order to determine if the ability to produce local lesions on guar could be restored by inoculating the virus back to sannhemp, the inoculum from tobacco was inoculated on sannhemp plants on which it induced mosaic symptoms after a long incubation period of 21–25 days. The inoculum from these sannhemp plants produced characteristic local lesions on guar plants. The SMV normally produces systemic mosaic symptoms within 7–10 days when inoculated from sannhemp to sannhemp or tobacco to tobacco but in cross-inoculations from sannhemp to tobacco or tobacco to sannhemp, the incubation period is prolonged to about 3–4 weeks.

Effect of High Temperatures on Symptoms Induced on Sannhemp.—The sannhemp mosaic virus when inoculated on sannhemp plants normally does not produce any symptoms on the inoculated leaves. It was, however, observed that when the inoculations of the virus were made at high temperatures during summer (above 106° F.) the infective sap produced necrotic local lesions on the inoculated leaves of sannhemp plants. The local lesions appeared on the third day of inoculation in the form of small brown spots which turned necrotic and increased in diameter within two days of their appearance (Fig. 1). This was followed by systemic mosaic symptoms characteristic of SMV on the young leaves with 7–10 days of inoculation. The infective sap taken from such plants produced local lesions on guar.

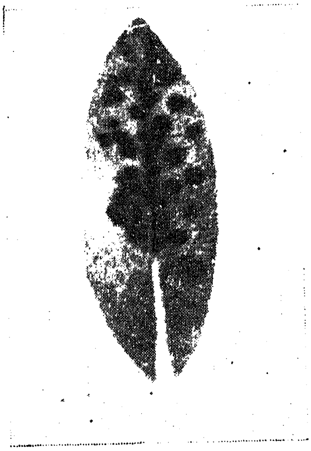


FIG. 1. Local lesions produced by sannhemp mosaic virus on inoculated leaf of sannhemp at high temperature.

The strange behaviour of the sannhemp mosaic virus when multiplying in different hosts is believed to be a host-induced change and is attributed to reversible mutations brought about by the virus by its passage through a particular host as reported by Bawden.[2]

The authors are grateful to Dr. S. P. Raychaudhuri, Head of the Division, for his keen interest and critically going through the manuscript.

Division of Mycology and
Plant Pathology,
Ind. Agri. Res. Inst.,
New Delhi-12, *December* 12, 1969.
T. K. NARIANI.
K. K. KARTHA.

---

1. Bawden, F. C., *Nature, Lond.*, 1954, **177**, 302.
2. —, *J. Gen. Microbiol.*, 1958, **18**, 751.
3. Capoor, S. P., *Phytopathology*, 1962, **52**, 393.
4. Kartha, K. K. and Nariani, T. K., *Indian Phytopath.*, 1969, **22**, 128.
5. Raychaudhuri, S. P., Nariani, T. K. and Das, C. R., *Ibid.*, 1962, **15**, 79.

STUDIES ON THE POLLEN GRAINS OF *URENA LOBATA* LINN.

THE present investigation comprises the study of the pollen grains of *Urena lobata* Linn., a tall erect undershrub with bright pink flower commonly seen in waste places of Banaras Hindu University campus. Pollen grains of Malvaceæ have been worked out by Banerjee,[1] Trevor,[2] Nair[3] and Prasad[4] from India, but there is no record of the presence of dimorphism in pollen grains of *Urena lobata*.

Polliniferous materials obtained from plants growing in the campus were collected in glacial acetic acid, and slides were prepared after Erdtman's[5] revised method of acetolysis. For measurements 20 grains have been taken into account while the illustrations are magnified to × 250.

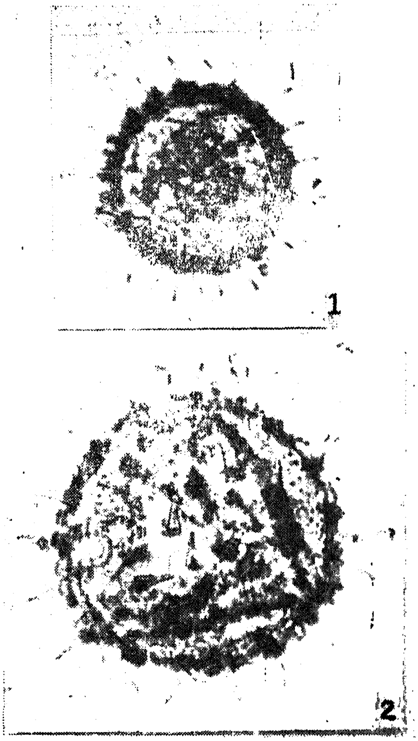
TABLE I

Difference in the two forms of grains of Urena lobata

Sl. No.	Character	Form *a*	Form *b*
1	Average size	171·2 μ	197·6 × 172·8 μ
2	Range in size	152–188 μ	188–220 × 176–200 μ
3	Pore	Oval, 4–6 μ	elliptical, 10–12 μ
4	Exine	8–10 μ	5–6 μ
5	Spine	long, straight closely set	long, curved, widely spaced
6	Average inter-spinal distance	20 μ	35 μ
7	Percentage	37·5	62·5

The pollen grains are polyforate, spinose, spheroidal, echinate, sticky and yellow to yellowish-brown in colour. The size, spines, apertures and thickness of wall exhibit variations which make it possible to categorize them into two groups, *a* and *b*.

Group a: small thick and dense-spine form (Fig. 1).—The average size of the spherical pollen grains is 171·2 μ, range 152–188 μ (including spines), pore oval, 4–6 μ in diameter, margin clear with an average interporal distance 20 μ. Exine 8–10 μ thick, nexine is much thicker than sexine. Spines long, 20 μ in size, conical with blunt apex, mostly straight, few are variously curved with an average interspinal distance 20 μ.



FIGS. 1–2. Microphotographs showing dimorphism in pollen grains of *Urena lobata*.

Group b: Bigger, thin and scattered-spine form (Fig. 2).—The pollen grains are oval to spheroidal in shape, average 197·6 × 172·8 μ in size, range 188–220 × 176–200 μ (including spines), pore elliptical, big, 10–12 μ in diameter, margin clear with an average interporal distance 20 μ. Exine 5–6 μ thick, nexine is thicker than sexine. Spines long, 16–20 μ, conical or with bulbous base, apex blunt, mostly curved, few straight with an average interspinal distance 35 μ.

Botany Department, R. C. GUPTA.
Banaras Hindu University, S. K. ROY.
Varanasi-5, *November* 29, 1969.

---

1. Banerjee, I., *Agric. J. India*, 1929, **24**, 332.
2. Trevor, T., *Ibid.*, 1930, **25**, 26.
3. Nair, P. K. K., *J. Sci. Industr. Res.*, 1958, **17 C**, 35.
4. Prasad, S. S., *J. Indian bot. Soc.*, 1963, **42**, 463.
5. Erdtman, G., *Svensk. bot. Tidskr*, 1960, **54**, 561.

INHERITANCE OF CLUSTERS PER NODE IN MUNGBEAN (*PHASEOLUS AUREUS* ROXB.)

A BREEDER is interested in finding types that contribute to high yield and in knowing the genetics of such characters that are associated directly with high yield. In mungbean, cluster number is positively associated with grain yield (Malhotra[1]). Most of the mungbean types have one cluster per node but rarely types appear with three clusters per node. These types with more clusters per node are likely to be high yielders. The efforts are underway to transfer multi-cluster per node habit into superior strains at Punjab Agricultural University. The knowledge of inheritance pattern of such characters would help plant breeder in efficient handling of the material. The present investigation was carried out to determine the mode of inheritance of clusters per node.

In crosses between fruiting type L 24–2 with three clusters per node and the type Hyb. 45 and P 23–67 with one cluster at a node, the latter has been found to be dominant in F_1. In F_2 and back-cross generations, the segregation patterns are shown (Table I).

The F_2 data gave a good fit to a 3 : 1 ratio. Thus the two contrasting characters, *viz.*, one cluster at a node *vs.* three clusters at a node are controlled by one major gene with three clusters at a node inherited as a simple recessive. The above finding was further substantiated by the 1 : 1 segregations in back-cross with the recessive parent, *viz.*, L 24–2.

Thus it is concluded that one cluster per node was monogenically dominant over the three clusters at a node. It is proposed to assign gene symbol for this trait as C–c.

TABLE I

Classification of F_2 plants and goodness of fit to ratio of 3 : 1

Cross	No. of plants with one cluster/node	No. of plants with three clusters at a node	Total number of plants	X^2	P value
Hyb. 45 × L 24-2	83	25	108	0·1974	·50–·75
P 23-67 × L 24-2	100	36	136	0·1215	·50–·75
(Hyb. 45 × L 24-2) × L 24-2	8	7	15	0·0166	·75–·90
(P 23-67 × L 24-2) × L 24-2	11	17	28	1·2856	·10–·20

Dept. of Plant Breeding, TEJINDER P. SINGH.
Punjab Agric. University, K. B. SINGH.
Ludhiana, *December* 10, 1969.

---

1. Malhotra, R. S., "Genetic variability and correlation studies in *Mung* (*Phaseolus aureus* Roxb.)," *M.Sc. Thesis*, Punjab Agricultural University, Ludhiana, 1968.

The strange behaviour of the sannhemp mosaic virus when multiplying in different hosts is believed to be a host-induced change and is attributed to reversible mutations brought about by the virus by its passage through a particular host as reported by Bawden.[2]

The authors are grateful to Dr. S. P. Raychaudhuri, Head of the Division, for his keen interest and critically going through the manuscript.

Division of Mycology and Plant Pathology,
Ind. Agri. Res. Inst.,
New Delhi-12, *December* 12, 1969.
T. K. NARIANI.
K. K. KARTHA.

---

1. Bawden, F. C., *Nature, Lond.*, 1954, **177**, 302.
2. —, *J. Gen. Microbiol.*, 1958, **18**, 751.
3. Capoor, S. P., *Phytopathology*, 1962, **52**, 393.
4. Kartha, K. K. and Nariani, T. K., *Indian Phytopath.*, 1969, **22**, 128.
5. Raychaudhuri, S. P., Nariani, T. K. and Das, C. R., *Ibid.*, 1962, **15**, 79.

STUDIES ON THE POLLEN GRAINS OF *URENA LOBATA* LINN.

THE present investigation comprises the study of the pollen grains of *Urena lobata* Linn., a tall erect undershrub with bright pink flower commonly seen in waste places of Banaras Hindu University campus. Pollen grains of Malvaceæ have been worked out by Banerjee,[1] Trevor,[2] Nair[3] and Prasad[4] from India, but there is no record of the presence of dimorphism in pollen grains of *Urena lobata*.

Polliniferous materials obtained from plants growing in the campus were collected in glacial acetic acid, and slides were prepared after Erdtman's[5] revised method of acetolysis. For measurements 20 grains have been taken into account while the illustrations are magnified to × 250.

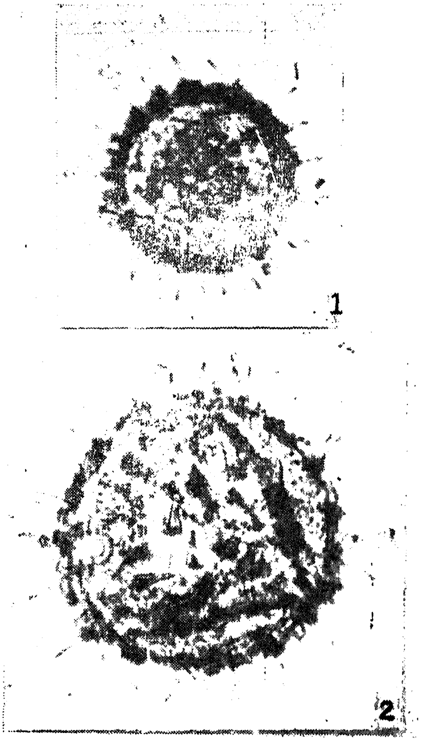
TABLE I

Difference in the two forms of grains of Urena lobata

Sl. No.	Character	Form *a*	Form *b*
1	Average size	$171\cdot2\ \mu$	$197\cdot6\times172\cdot8\ \mu$
2	Range in size	$152–188\ \mu$	$188–220\times176–200\ \mu$
3	Pore	Oval, $4–6\ \mu$	elliptical, $10–12\ \mu$
4	Exine	$8–10\ \mu$	$5–6\ \mu$
5	Spine	long, straight closely set	long, curved, widely spaced
6	Average inter-spinal distance	$20\ \mu$	$35\ \mu$
7	Percentage	37·5	62·5

The pollen grains are polyforate, spinose, spheroidal, echinate, sticky and yellow to yellowish-brown in colour. The size, spines, apertures and thickness of wall exhibit variations which make it possible to categorize them into two groups, *a* and *b*.

Group a: small thick and dense-spine form (Fig. 1).—The average size of the spherical pollen grains is $171\cdot2\ \mu$, range $152–188\ \mu$ (including spines), pore oval, $4–6\ \mu$ in diameter, margin clear with an average interporal distance $20\ \mu$. Exine $8–10\ \mu$ thick, nexine is much thicker than sexine. Spines long, $20\ \mu$ in size, conical with blunt apex, mostly straight, few are variously curved with an average interspinal distance $20\ \mu$.



FIGS. 1-2. Microphotographs showing dimorphism in pollen grains of *Urena lobata*.

Group b: Bigger, thin and scattered-spine form (Fig. 2).—The pollen grains are oval to spheroidal in shape, average $197\cdot6\times172\cdot8\ \mu$ in size, range $188–220\times176–200\ \mu$ (including spines), pore elliptical, big, $10–12\ \mu$ in diameter, margin clear with an average interporal distance $20\ \mu$. Exine $5–6\ \mu$ thick, nexine is thicker than sexine. Spines long, $16–20\ \mu$, conical or with bulbous base, apex blunt, mostly curved, few straight with an average interspinal distance 35 μ.

Botany Department, R. C. GUPTA.
Banaras Hindu University, S. K. ROY.
Varanasi-5, *November* 29, 1969.

---

1. Banerjee, I., *Agric. J. India*, 1929, **24**, 332.
2. Trevor. T., *Ibid.*, 1930, **25**, 26.
3. Nair, P. K. K., *J. Sci. Industr. Res.*, 1958, **17 C**, 35.
4. Prasad, S. S., *J. Indian bot. Soc.*, 1963, **42**, 463.
5. Erdtman, G., *Svensk. bot. Tidskr*, 1960, **54**, 561.

INHERITANCE OF CLUSTERS PER NODE IN MUNGBEAN (*PHASEOLUS AUREUS* ROXB.)

A BREEDER is interested in finding types that contribute to high yield and in knowing the genetics of such characters that are associated directly with high yield. In mungbean, cluster number is positively associated with grain yield (Malhotra[1]). Most of the mungbean types have one cluster per node but rarely types appear with three clusters per node. These types with more clusters per node are likely to be high yielders. The efforts are underway to transfer multi-cluster per node habit into superior strains at Punjab Agricultural University. The knowledge of inheritance pattern of such characters would help plant breeder in efficient handling of
material. The present investigation v
carried out to determine the mode of inheritar
of clusters per node.

In crosses between fruiting type L 24–2 w
three clusters per node and the type H
45 and P 23–67 with one cluster at a node,
latter has been found to be dominant in
In F_2 and back-cross generations, the segreg
tion patterns are shown (Table I).

The F_2 data gave a good fit to a 3 : 1 ra
Thus the two contrasting characters, *viz.*,
cluster at a node *vs.* three clusters at a n
are controlled by one major gene with th
clusters at a node inherited as a sim
recessive. The above finding was further su
stantiated by the 1 : 1 segregations in ba
cross with the recessive parent, *viz.*, L 24

Thus it is concluded that one cluster
node was monogenically dominant over
three clusters at a node. It is proposed
assign gene symbol for this trait as C-c.

TABLE I

Classification of F_2 plants and goodness of fit to ratio of 3 : 1

Cross	No. of plants with one cluster/node	No. of plants with three clusters at a node	Total number of plants	X^2	P valu
Hyb. 45 × L 24–2	83	25	108	0·1974	·50–·
P 23–67 × L 24–2	100	36	136	0·1215	·50–·
(Hyb. 45 × L 24–2) × L 24–2	8	7	15	0·0166	·75–·
(P 23–67 × L 24–2) × L 24–2	11	17	28	1·2856	·10–·

Dept. of Plant Breeding, TEJINDER P. SIN
Punjab Agric. University, K. B. SINGH.
Ludhiana, *December* 10, 1969.

---

1. Malhotra, R. S., "Genetic variability and correla
studies in *Mung* (*Phaseolus aureus* Roxl
M.Sc. Thesis, Punjab Agricultural Univer
Ludhiana, 1968.

The strange behaviour of the sannhemp mosaic virus when multiplying in different hosts is believed to be a host-induced change and is attributed to reversible mutations brought about by the virus by its passage through a particular host as reported by Bawden.[2]

The authors are grateful to Dr. S. P. Raychaudhuri, Head of the Division, for his keen interest and critically going through the manuscript.

Division of Mycology and Plant Pathology,
Ind. Agri. Res. Inst.,
New Delhi-12, *December* 12, 1969.

T. K. NARIANI.
K. K. KARTHA.

---

1. Bawden, F. C., *Nature, Lond.*, 1954, **177**, 302.
2. —, *J. Gen. Microbiol.*, 1958, **18**, 751.
3. Capoor, S. P., *Phytopathology*, 1962, **52**, 393.
4. Kartha, K. K. and Nariani, T. K., *Indian Phytopath.*, 1969, **22**, 128.
5. Raychaudhuri, S. P., Nariani, T. K. and Das, C. R., *Ibid.*, 1962, **15**, 79.

STUDIES ON THE POLLEN GRAINS OF *URENA LOBATA* LINN.

THE present investigation comprises the study of the pollen grains of *Urena lobata* Linn., a tall erect undershrub with bright pink flower commonly seen in waste places of Banaras Hindu University campus. Pollen grains of Malvaceæ have been worked out by Banerjee,[1] Trevor,[2] Nair[3] and Prasad[4] from India, but there is no record of the presence of dimorphism in pollen grains of *Urena lobata.*

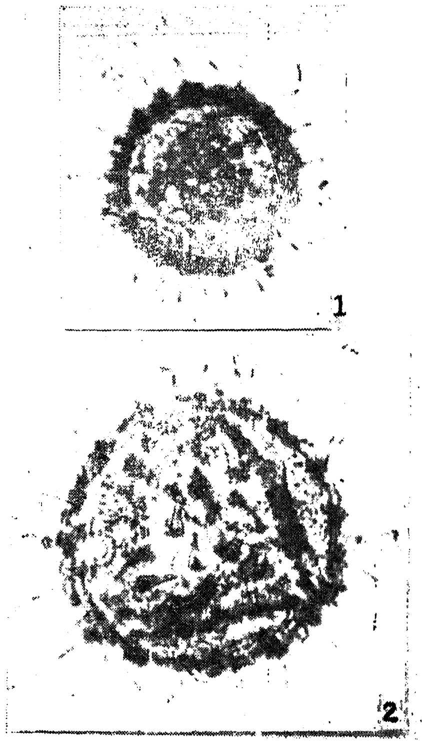
Polliniferous materials obtained from plants growing in the campus were collected in glacial acetic acid, and slides were prepared after Erdtman's[5] revised method of acetolysis. For measurements 20 grains have been taken into account while the illustrations are magnified to × 250.

TABLE I
Difference in the two forms of grains of Urena lobata

Sl. No.	Character	Form *a*	Form *b*
1	Average size	171·2 μ	197·6 × 172·8 μ
2	Range in size	152–188 μ	188–220 × 176–200 μ
3	Pore	Oval, 4–6 μ	elliptical, 10–12 μ
4	Exine	8–10 μ	5–6 μ
5	Spine	long, straight closely set	long, curved, widely spaced
6	Average inter-spinal distance	20 μ	35 μ
7	Percentage	37·5	62·5

The pollen grains are polyforate, spinose, spheroidal, echinate, sticky and yellow to yellowish-brown in colour. The size, spines, apertures and thickness of wall exhibit variations which make it possible to categorize them into two groups, *a* and *b*.

Group a: small thick and dense-spine form (Fig. 1).—The average size of the spherical pollen grains is 171·2 μ, range 152–188 μ (including spines), pore oval, 4–6 μ in diameter, margin clear with an average interporal distance 20 μ. Exine 8–10 μ thick, nexine is much thicker than sexine. Spines long, 20 μ in size, conical with blunt apex, mostly straight, few are variously curved with an average interspinal distance 20 μ.



FIGS. 1–2. Microphotographs showing dimorphism in pollen grains of *Urena lobata.*

Group b: Bigger, thin and scattered-spine form (Fig. 2).—The pollen grains are oval to spheroidal in shape, average 197·6 × 172·8 μ in size, range 188–220 × 176–200 μ (including spines), pore elliptical, big, 10–12 μ in diameter, margin clear with an average interporal distance 20 μ. Exine 5–6 μ thick, nexine is thicker than sexine. Spines long, 16–20 μ, conical or with bulbous base, apex blunt, mostly curved, few straight with an average interspinal distance 35 μ.

Botany Department, R. C. GUPTA.
Banaras Hindu University, S. K. ROY.
Varanasi-5, *November* 29, 1969.

---

1. Banerjee, I., *Agric. J. India*, 1929, **24**, 332.
2. Trevor, T., *Ibid.*, 1930, **25**, 26.
3. Nair, P. K. K., *J. Sci. Industr. Res.*, 1958, **17 C**, 35.
4. Prasad, S. S., *J. Indian bot. Soc.*, 1963, **42**, 463.
5. Erdtman, G., *Svensk. bot. Tidskr*, 1960, **54**, 561.

INHERITANCE OF CLUSTERS PER NODE IN MUNGBEAN (*PHASEOLUS AUREUS* ROXB.)

A BREEDER is interested in finding types that contribute to high yield and in knowing the genetics of such characters that are associated directly with high yield. In mungbean, cluster number is positively associated with grain yield (Malhotra[1]). Most of the mungbean types have one cluster per node but rarely types appear with three clusters per node. These types with more clusters per node are likely to be high yielders. The efforts are underway to transfer multi-cluster per node habit into superior strains at Punjab Agricultural University. The knowledge of inheritance pattern of such characters would help plant breeder in efficient handling of the material. The present investigation was carried out to determine the mode of inheritance of clusters per node.

In crosses between fruiting type L 24–2 with three clusters per node and the type Hyb. 45 and P 23–67 with one cluster at a node, the latter has been found to be dominant in F_1. In F_2 and back-cross generations, the segregation patterns are shown (Table I).

The F_2 data gave a good fit to a 3 : 1 ratio. Thus the two contrasting characters, *viz.*, one cluster at a node *vs.* three clusters at a node are controlled by one major gene with three clusters at a node inherited as a simple recessive. The above finding was further substantiated by the 1 : 1 segregations in back-cross with the recessive parent, *viz.*, L 24–2.

Thus it is concluded that one cluster per node was monogenically dominant over the three clusters at a node. It is proposed to assign gene symbol for this trait as C-c.

TABLE I

Classification of F_2 plants and goodness of fit to ratio of 3 : 1

Cross	No. of plants with one cluster/node	No. of plants with three clusters at a node	Total number of plants	X^2	P value
Hyb. 45 × L 24–2	83	25	108	0·1974	·50–·75
P 23–67 × L 24–2	100	36	136	0·1215	·50–·75
(Hyb. 45 × L 24–2) × L 24–2	8	7	15	0·0166	·75–·90
(P 23–67 × L 24–2) × L 24–2	11	17	28	1·2856	·10–·20

Dept. of Plant Breeding, TEJINDER P. SINGH.
Punjab Agric. University, K. B. SINGH.
Ludhiana, *December* 10, 1969.

---

1. Malhotra, R. S., "Genetic variability and correlation studies in *Mung* (*Phaseolus aureus* Roxb.)," *M.Sc. Thesis*, Punjab Agricultural University, Ludhiana, 1968.

REVIEWS AND NOTICES OF BOOKS

Chemical Rockets. Edited by Richard T. Holzmann. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. ix + 449. Price $ 25.75.

One of the vital needs in the field of propulsion and chemical rockets is a volume dealing with the latest fundamental research discoveries in synthetic and thermochemistry. This book encompasses the newest developments in chemical research as it relates to rockets. All previous works have been concerned with historical developments more than ten years old. Only recently have results of the past decade been published, and these in widely scattered journals. *Chemical Rockets and Flame and Explosives Technology* bridges this information gap and predicts achievable chemical rocket performance in future decades. This book critically reviews synthetic chemistry and thermodynamics and the impact these have on performance, missile control and guidance, and on materials of construction.

The contents of this volume are: The Place of Chemical Rockets in Advanced Propulsion Concepts; A Review of Operational Propellants —Their History and Current Usage; A Review of Developmental Propellants; The Importance of Thermochemistry, Performance Calculations, and Combustion; Special Topics; The Nature of the Advanced Propellant; Appendix A: Rocket Propulsion Elements; Appendix B: Flame Technology Compared with Propellant Technology; and Appendix C: Explosives Technology Compared with Propellant Technology.

This book is of value to the aerospace industry, explosives and propellant groups, amateur rocketeers, and all those interested in combustion and high temperature phenomena, and in chemical propulsion. C. V. R.

The Evolution of Man and Society. By C. D. Darlington. (George Allen and Unwin Ltd., Ruskin House, Museum St., London), 1969. Pp. 753. Price 70 *sh.* net.

The Evolution of Man and Society is a great book which may well remain Professor Darlington's *magnum opus.* It is an extensive, deep and scholarly survey of the history and growth of human society and so, of civilization.

Human Society as it is observed amongst the various peoples of the world and in various parts of the world is so complex that in its evolution many factors are involved. But the most basic of all is the genetic factor. Professor Darlington, an authority on plant genetics, looks at the origin, evolution and growth of human society from this point of view, and brings to his argument evidences based on latest advances in different disciplines of science such as anthropology, archæology, etc., besides genetics itself.

The evolution of human society essentially arises from the individual aptitude of men and their behaviour towards one another; in other words from their character, which in the long run is conditioned by genetic processes. These genetic processes are entirely at the mercy of the system of breeding. "Control of breeding system, whether operating merely physiologically as in plants or physiologically and socially as in animals, is always in its basis genetic; it is always a part of heredity" (p. 61).

"Heredity is connected with reproduction; reproduction is connected with the customs of the community, and the customs of the community are connected with the aggregate or average instincts of the individuals composing it for many past generations; how many generations depending on how long the community has existed as a breeding unit" (p. 64). Further, inbreeding in isolated communities is antagonistic to environmental changes while outbreeding leading to new genetic combinations produces more resistant varieties and so survive.

It is against the background of these fundamental biological principles that Prof. Darlington has written this book. It will be a source book for further researches and also a shelf companion to the general intelligent reader. The vast amount of information it contains can be judged from the following Sectional and Chapter headings:

I. The Foundations (Origin of Man, Expanding Species, Breeding Systems). II. Provident Societies (Coming of Agriculture, Babylonia, Egypt). III. Expanding Peoples (Making of Europe, The Greeks, Semites and Jews). IV. The Process of Empire (Persia, Macedon, Rome, Augustus and the Empire),

V. World [illegible] [illegible] Plan, Handicraft; VI. The Emergence of Europe ([illegible] Century [illegible] New Nations, Northern Influence [illegible]); VII. Societies in Conflict (The Reformation and the Church, The Reformation and Scientific Revolution in the West, Revolution in the East); VIII. Separate Worlds (America, China, Oceania, Africa).

The book contains 22 maps and diagrams, 44 tables and charts and 18 [illegible].

A. S. G.

Metric Change in India. Edited by Lal C. Verman and Jainath Kaul. (Indian Standards Institution, 9 Bahadur Shah Zafar Marg, New Delhi-1), 1970. Pp. [illegible] 429. Price Rs. 60·00; [illegible] 6·00.

The change over to the metric system is a great achievement for free India. Some of the advanced countries are yet to complete their [illegible] conversion programme.

The first decision for the metric switch over in India was taken in 1956 and a ten-year plan was adopted to effect the change. The systematic account of the progress of change-over during these ten years, phase by phase, sector by sector, is presented in this first [illegible] of its kind. Nearly thirty [illegible] in science, industry, education and others have contributed to the book. Each chapter has been written by persons directly concerned with the particular topic in the programmed plan.

The first two chapters are very informative and of interest, as they give respectively, the international background of the Metric System and the early history and developments in India culminating in the final legislative decision to make India go metric in weights, measures and coinage.

The breadth and interdisciplinary nature of the coverage (basic standards, meteorology, railways, shipping, civil aviation, post and telegraphs, engineering and industries, education, etc.) make the book an informative, well-documented and authentic reference work.

Besides being useful to the advanced countries, some of whose problems are very much the same, the book will be of particular interest to the developing countries.

A. S. G.

Indian Thysanoptera. By T. N. Ananthakrishnan. (Publications and Information Directorate, CSIR, New Delhi), 1969. Pp. 171. Price Rs. 26·00; *sh.* 52·00; $ 8.00.

Indian Thysanoptera is the first in the series of Zoological Monographs issued by the CSIR. The author who has been making special studies on this order of insects is known for his contributions on the subject over the past two decades. In this monograph, besides the taxonomic aspect, the subject is treated in a larger perspective from the point of view of general ecology, comparative morphology, and agricultural importance as will be evident from the following headings: Introduction; Bionomics; Taxonomy; General Morphology; Reproduction and Development; Structural Diversity in Natural Populations; and Thrips in Agriculture and Horticulture.

The book is illustrated with 38 drawings and 11 plates. A 30-page *Appendix* gives a classified list of species of Indian Thysanoptera (Suborder Terebrantia and Suborder Tubulifera). The monograph should be useful to students as well as research workers in the field.

A. S. G.

Books Received

Introduction to Physical Organic Chemistry. By R. D. Gilliom. (Addison-Wesley Publishing Co., West End House, 11, Hills Place, London W. 1, England), 1970. Pp. vii + 342. Price 126 *sh.*

The Geological Society of America: Memoir 110. Studies of Geology and Hydrology of Nevada Test Site. Edited by Edwin B. Eckel. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. xii + 290. Price $ 8.50.

Memoir 106. Annotated Index of Fossil and Recent Silicoflagellates and Ebridians with Descriptions and Illustrations of Validly Proposed Taxa. By A. R. Loeblich III, L. A. Loeblich, H. Tappan and A. R. Loeblich Jr. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. xi + 319. Price $ 12.50.

Memoir 107. Tidal Flat Sedimentation on the Colorado River Delta, Northwestern Gulf of California. By R. W. Thompson. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. xii + 133. Price $ 9.50.

2007 70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

REVIEWS AND NOTICES OF BOOKS

Chemical Rockets. Edited by Richard T. Holzmann. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. ix + 449. Price $ 25.75.

One of the vital needs in the field of propulsion and chemical rockets is a volume dealing with the latest fundamental research discoveries in synthetic and thermochemistry. This book encompasses the newest developments in chemical research as it relates to rockets. All previous works have been concerned with historical developments more than ten years old. Only recently have results of the past decade been published, and these in widely scattered journals. *Chemical Rockets and Flame and Explosives Technology* bridges this information gap and predicts achievable chemical rocket performance in future decades. This book critically reviews synthetic chemistry and thermodynamics and the impact these have on performance, missile control and guidance, and on materials of construction.

The contents of this volume are: The Place of Chemical Rockets in Advanced Propulsion Concepts; A Review of Operational Propellants —Their History and Current Usage; A Review of Developmental Propellants; The Importance of Thermochemistry, Performance Calculations, and Combustion; Special Topics; The Nature of the Advanced Propellant; Appendix A: Rocket Propulsion Elements; Appendix B: Flame Technology Compared with Propellant Technology; and Appendix C: Explosives Technology Compared with Propellant Technology.

This book is of value to the aerospace industry, explosives and propellant groups, amateur rocketeers, and all those interested in combustion and high temperature phenomena, and in chemical propulsion. C. V. R.

The Evolution of Man and Society. By C. D. Darlington. (George Allen and Unwin Ltd., Ruskin House, Museum St., London), 1969. Pp. 753. Price 70 *sh.* net.

The Evolution of Man and Society is a great book which may well remain Professor Darlington's *magnum opus.* It is an extensive, deep and scholarly survey of the history and growth of human society and so, of civilization.

Human Society as it is observed amongst the various peoples of the world and in various parts of the world is so complex that in its evolution many factors are involved. But the most basic of all is the genetic factor. Professor Darlington, an authority on plant genetics, looks at the origin, evolution and growth of human society from this point of view, and brings to his argument evidences based on latest advances in different disciplines of science such as anthropology, archæology, etc., besides genetics itself.

The evolution of human society essentially arises from the individual aptitude of men and their behaviour towards one another; in other words from their character, which in the long run is conditioned by genetic processes. These genetic processes are entirely at the mercy of the system of breeding. "Control of breeding system, whether operating merely physiologically as in plants or physiologically and socially as in animals, is always in its basis genetic; it is always a part of heredity" (p. 61).

"Heredity is connected with reproduction; reproduction is connected with the customs of the community, and the customs of the community are connected with the aggregate or average instincts of the individuals composing it for many past generations; how many generations depending on how long the community has existed as a breeding unit" (p. 64). Further, inbreeding in isolated communities is antagonistic to environmental changes while outbreeding leading to new genetic combinations produces more resistant varieties and so survive.

It is against the background of these fundamental biological principles that Prof. Darlington has written this book. It will be a source book for further researches and also a shelf companion to the general intelligent reader. The vast amount of information it contains can be judged from the following Sectional and Chapter headings:

I. The Foundations (Origin of Man, Expanding Species, Breeding Systems). II. Provident Societies (Coming of Agriculture, Babylonia, Egypt). III. Expanding Peoples (Making of Europe, The Greeks, Semites and Jews). IV. The Process of Empire (Persia, Macedon, Rome, Augustus and the Empire),

V. World Religions (Christianity, Islam, Hinduism). VI. The Emergence of Europe (Southern Successors, New Nations, Northern Intruders, Jewish Involvement). VII. Societies in Conflict (The Reformation and the Church, The Reformation and Society, Revolution in the West, Revolution in the East). VIII. Separate Worlds (America, China, Oceania, Africa).

The book includes 22 maps and diagrams, 44 tables and charts and 18 pedigrees.

A. S. G.

Metric Change in India. Editors: Lal C. Verman and Jainath Kaul. (Indian Standards Institution, 9, Bahadur Shah Zafar Marg, New Delhi-1), 1970. Pp. xxviii + 529. Price Rs. 60·00; $ 15·00; £ 6·00.

The change-over to the metric system is a great accomplishment for free India. Some of the advanced countries are yet to complete their proposed conversion programmes.

The first decision on the metric switch-over in India was taken in 1956 when a ten-year plan was adopted to effect the change. The systematic account of the progress of change-over during these ten years, phase by phase, sector by sector is presented in this first chronicle of metric switch-over. Nearly thirty scientists, technologists, administrators, educators and others have contributed to this book. Each chapter has been written by persons directly concerned with the particular topic in this programmed plan.

The first two chapters are very informative and of interest, as they give, respectively, the international background to the Metric System, and its early history and development in India culminating in the final legislative decision to make India go metric in weights, measures and coinage.

The breadth and interdisciplinary nature of the coverage—basic standards, meteorology, railways, shipping, civil aviation, posts and telegraphs, engineering and industries, education, etc.,—make the book an informative, well-documented and authentic reference work.

Besides being useful to the advanced countries, some of whose problems are very much the same, the book will be of particular interest to the developing countries.

A. S. G.

Indian Thysanoptera. By T. N. Ananthakrishnan. (Publications and Information Directorate, CSIR, New Delhi), 1969. Pp. 171. Price Rs. 26·00; *sh.* 52·00; $ 8.00.

Indian Thysanoptera is the first in the series of Zoological Monographs issued by the CSIR. The author who has been making special studies on this order of insects is known for his contributions on the subject over the past two decades. In this monograph, besides the taxonomic aspect, the subject is treated in a larger perspective from the point of view of general ecology, comparative morphology, and agricultural importance as will be evident from the following headings: Introduction; Bionomics; Taxonomy; General Morphology; Reproduction and Development; Structural Diversity in Natural Populations; and Thrips in Agriculture and Horticulture.

The book is illustrated with 38 drawings and 11 plates. A 30-page *Appendix* gives a classified list of species of Indian Thysanoptera (Suborder Terebrantia and Suborder Tubulifera). The monograph should be useful to students as well as research workers in this field.

A. S. G.

Books Received

Introduction to Physical Organic Chemistry. By R. D. Gilliom. (Addison-Wesley Publishing Co., West End House, 11, Hills Place, London W. 1, England), 1970, Pp. vii + 342. Price 126 *sh.*

The Geological Society of America: Memoir 110—Studies of Geology and Hydrology of Nevada Test Site. Edited by Edwin B. Eckel. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. vii + 290. Price $ 8.50.

Memoir 106—Annotated Index of Fossil and Recent Silicoflagellates and Ebridians with Descriptions and Illustrations of Validly Proposed Taxa. By A. R. Loeblich III, L. A. Loeblich, H. Tappan and A. R. Loeblich Jr. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. xi + 319. Price $ 12.50.

Memoir 107—Tidal Flat Sedimentation on the Colorado River Delta, Northwestern Gulf of California. By R. W. Thompson. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. xii + 133. Price $ 9.50.

2007-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

Phone : 572305 Grams : 'TEMPOVEN, SZ

Precision stabilized

THERMISTORS

Now manufactured in India by :

TEMPO INDUSTRIAL CORPORATION

18-C, Paranjape 'B' Scheme,
Subhasha Road, Vile Parle (East),
BOMBAY 57 AS.

Types available :

BEADS	PROBES
• MICRO BEADS	• GLASS PROBES
• BARE BEADS	• STAINLESS STEEL PROBES
• EPOXY COATED BEADS	• TEFLON PROBES

Disc Thermistors for Transistor Radios &

CERAMIC MAGNET.

Journal of the
INDIAN BOTANICAL SOCIETY

The J. Indian bot. Soc. *is a QUARTERLY*
now running Volume 48 (1969)

The Annual Subscription is Rs. 30·00 or £ 2-10-0 or $ 7.50 for a complete volume of four numbers.

BACK NUMBERS of the Journal and SPECIAL PUBLICATIONS, such as History of Botanical Researches in India, Burma & Ceylon (Parts I, II & III) and MEMOIRS I, 2 & 3 of the Society are available.

For Particulars and Prices, Please write to :

BUSINESS MANAGER & TREASURER
Indian Botanical Society
Department of Botany
Andhra University
WALTAIR

JUST PUBLISHED

INDIAN THYSANOPTERA

By

T. N. ANANTHAKRISHNAN, Director, Entomology Research Unit, Loyola College, MADRAS

The first in the zoological monograph series published by the Publications & Information Directorate, CSIR, the monograph contains a detailed study of insects belonging to the Order Thysanoptera, commonly called thrips. More than 400 species belonging to about 200 different genera are covered.

The bionomics, taxonomy, morphology, reproduction and development and structural diversity of thrips and their role as pests in agriculture and horticulture are dealt with. An appendix listing all Indian species and an exhaustive bibliography containing 345 references are valuable additions.

Of use to students, teachers and research workers.

Pages viii + 171, royal 8 Vo. 10 Plates and 38 text illustrations

Price : Rs. 26·00 ; Sh. 52 ; $ 8.00

Can be had from

Sales & Distribution Section
Publications & Information Directorate, CSIR
Hill side Road, New Delhi 12

EVALUATION OF DIFFERENT LEAF PROTEIN CONCENTRATES FOR SOME ESSENTIAL AMINO-ACIDS

J. S. GARCHA, B. L. KAWATRA[*] AND D. S. WAGLE[**]

Department of Chemistry and Biochemistry, Punjab Agricultural University, Ludhiana

INTRODUCTION

THE use of leaf proteins in the alleviation of protein mal-nutrition has been suggested by many workers.[1-3] Pleshkov and Fowden[4] and Gerloff *et al.*[5] have suggested that leaf proteins being a mixture of a number of proteins occurring in metabolically active tissues of plants would be of superior quality because of balanced amino-acids make-up as compared to reserve plant proteins such as seed proteins. Information on essential amino-acid content of such proteins is necessary to identify those proteins which can improve the protein quality of ordinary diets. The present communication reports studies on the composition of protein isolates prepared from leaves of twenty different vegetable and fodder crops. The amino-acids estimated were total lysine, available lysine, histidine, arginine, methionine and tryptophan.

EXPERIMENTAL

The leaf protein isolates were prepared from the different green leafy crops as described earlier.[6] Weighed samples of the isolates were ground in a pestle and mortar and defatted with petroleum ether (b.p. 40°–60°) in a soxhlet apparatus before using for animo-acid analysis. Samples were ground finally to pass through a 40-mesh sieve and preserved in air-tight polythene bottles for use as required.

Acid Hydrolysis.—Two hundred and fifty mg. of the defatted material were hydrolysed with 10 ml. of 6 N hydrochloric acid for 24 hours under reflux at 110° C. in sealed pyrex tubes. The hydrolysate was made to 50 ml. and then filtered. An aliquot (10 ml.) of the same was freed of excess acid by evaporation to near dryness followed by addition of small volume of distilled water thrice in succession. The final residue was taken up in sodium citrate buffer pH 2·2 and the volume made up to 10 ml.

Alkali Hydrolysis.—For the determination of tryptophan, 250 mg. of the defatted sample were hydrolysed in sealed tubes with 5 N sodium hydroxide for 18 hours under reflux at 110° C. in an air oven. The contents were transferred to 100 ml. volumetric flask and made to a known volume with distilled water. The hydrolysate was then filtered and stored in a refrigerator until use.

Methods of Analysis.—Total lysine, histidine and arginine were determined by the procedure of Moore *et al.*[7] using 15 cm. column filled with Amberlite IR-120 (250–300 mesh size) resin. Fractions of 2 ml. were collected manually with the help of a siphon and the colour was developed by the addition of 1 ml. of modified ninhydrin reagent.[8]

Available lysine was determined by 1-fluoro, 2 : 4-dinitrobenzene method.[9] Methionine[10] and tryptophan[11] were determined colorimetrically from the acid and alkali hydrolysates respectively. Nitrogen was determined by the micro Kjeldahl method and all the determinations were carried out in duplicates.

RESULTS AND DISCUSSION

The mean nitrogen and amino-acid contents of the leaf protein isolates are given in Table I. The nitrogen content of the defatted samples ranged from 8·61% to 11·86% in *salad* and *sarson* respectively. These differences may be partly due to differences in the species and partly in the degree of maturity. Smith and Agiza[11] also observed similar variations in four species.

Of the five amino-acids studied, *viz.*, total lysine, available lysine, histidine arginine, methionine and tryptophan, methionine varied from 1·36 g./16 g. N in *potato* to 2·63 g./16 g. N in *berseem*. A similar variation from 1·30 g./16 g. N to 2·70 g./16 g. N has been reported in other studies.[12-14] Tryptophan content ranged from 1·41 g./16 g. N to 2·42 g./16 g. N in *wheat* and *metha* respectively. However, these values are slightly higher when compared to values reported.[4,5] The lysine content varied from 4·99 g./16 g. N to 6·49 g./16 g. N in *radish* and *cowpea* respectively. Similar data have been reported by many

---

Present Addresses:

[*] Ph.D. student, Chemistry and Biochemistry Department, Punjab Agricultural University, Ludhiana.

[**] Associate Professor and Head, Department of Chemistry and Biochemistry, Haryana Agricultural University, Hissar (Haryana).

TABLE I

Nitrogen and some essential amino-acid composition of different leaf protein isolates (defatted samples)*

Latin name		Local name	Nitrogen per cent	g./16 g. N					
				Methionine	Tryptophan	Histidine	Arginine	Total lysine	Available lysine
Trifolium alexandrinum	..	Berseem	9·10	2·63	2·34	2·25	10·70	5·80	5·25
Medicago sativa	..	Lucerne	9·17	2·44	2·26	1·70	11·08	5·99	5·58
Cyamopsis psoralioides	..	Guar	10·08	1·90	2·22	2·61	11·17	6·30	5·65
Vigna sinensis	..	Cowpea	9·33	1·37	1·73	2·65	10·11	6·49	5·78
Triticum æstivum	..	Wheat	11·66	2·39	1·41	1·97	9·16	6·44	5·54
Trigonella fœnumgræcum	..	Metha	9·38	1·91	2·42	1·70	8·10	5·90	5·03
Hordeum vulgare	..	Barley	10·37	2·52	1·71	1·37	7·68	5·01	4·75
Trigonella fœnumgræcum	..	Methi	10·82	2·30	2·10	2·72	9·80	6·11	5·35
Brassica juncea	..	Raya	10·17	1·94	1·69	1·96	10·99	6·37	5·75
Brassica campestris	..	Sarson	11·86	1·38	1·46	1·93	9·30	5·91	5·75
Solanum tuberosum	..	Potato	9·33	1·36	1·78	1·72	11·60	5·98	5·26
Trifolium resupinatum	..	Shaftal	9·17	1·92	1·83	1·91	9·70	5·37	4·98
Beta bengalensis	..	Palak	9·31	1·68	1·63	1·55	10·34	5·92	5·52
Raphanus sativus	..	Radish	9·90	2·11	1·90	1·70	10·99	4·99	4·65
Brassica oleracea	..	Cabbage	9·88	1·83	1·80	1·50	11·25	5·86	5·64
Lactueca sativa	..	Salad	8·68	1·99	1·67	1·53	10·03	6·44	5·83
Brassica oleracea	..	Cauliflower	9·68	1·54	1·73	1·68	10·33	6·21	5·54
Avena sativa	..	Oats	10·01	1·53	1·90	1·48	7·79	5·59	4·99
Eruca sativa	..	Taramira	10·08	1·58	2·35	2·20	7·91	5·33	5·08
Brassica rapa	..	Turnip	8·98	2·21	2·01	1·50	8·99	5·70	5·15

* On dry matter basis.

workers.[4,5,15] The available lysine was also determined in the present investigation and it was found that more than 75% of the total lysine is in the available form. Histidine and arginine were found to range from 1·48 g./16 g. N in *oats* to 7·72 g./16 g. N in *methi* and 7·68 g./16 g. N (*barley*) to 11·60 g./16 g. N (*potato*) respectively. However, as the composition of leaf proteins may be expected to vary with genetic make-up, stage of maturity, environmental conditions and agronomic practices, more extensive data for controlling these factors are desirable.

Of the twenty species studied, five were found to be more than adequate with regard to methionine whereas most other proteins were deficient in this amino-acid. All of them are rich in lysine and most of them in tryptophan. Varieties rich in all the three amino-acids will be of great value in supplementing ordinary diets which are generally deficient in these amino-acids.

SUMMARY

The various leaf protein isolates obtained from twenty different crops were analysed for some of the essential amino-acids, *viz.*, total lysine, available lysine, histidine, arginine, methionine and tryptophan. Almost all the varieties were found to be rich in lysine and tryptophan. A few varieties were also rich in methionine whereas most varieties were deficient in this amino-acid.

---

1. Cannon, P. R., *Protein and Amino-acid Deficiency*, Springfield, 1948, p. 111.
2. Pirie, N. W., *Food Manufacturer*, 1957, **32**, 416.
3. Allison, J. B., *Physiol. Rev.*, 1955, **35**, 661.
4. Pleshkov, B. P. and Fowden, L., *Nature*, 1959, **183**, 1445.
5. Gerloff, E. D., Lima, I. H. and Stahmann, M. A., *J. Agric. Fd. Chem.*, 1965, **13**, 139.
6. Garcha, J. S., Kawatra, B. L., Wagle, D. S. and Bhatia, I. S., *J. Research*, Pb. Agri. University, Ludhiana (In press).
7. Moore, S., Spackman, D. H. and Stein, W. H., *Anal. Chem.*, 1958, **30**, 1185.
8. — and Stein, W. H., *J. Biol. Chem.*, 1954, **211**, 907.
9. Carpenter, K. J., *Biochem. J.*, 1960, **77**, 604.
10. Horn, M. J., Jones, D. B. and Blum, A. E., *J. Biol. Chem.*, 1946, **166**, 313.
11. Smith, A. M. and Agiza, A. H., *J. Sci. Fd. Agric.*, 1951, **2**, 508.
12. Lugg, J. W. H., *Advances in Protein Chem.*, **1949**, **5**, 229.
13. Kuppuswamy, S., Srinivasan, M. and Subrahmanyan, V., *Ind. Counce. Med. Res Rep. No. 33*, 1958, p. 221.
14. Waterlow, J. C., *Brit. J. Nutr.*, 1962, **16**, 531.
15. Singh, N., *A Report on Leaf Protein Work at C.F.T.R.I.*, Mysore (India), 1967.

ETHREL FOR BREAKING DORMANCY OF STRAWBERRY SEEDS*

C. P. A. IYER, ELIAS K. CHACKO AND M. D. SUBRAMANIAM

Institute of Horticultural Research (ICAR), 255, Upper Palace Orchards, Bangalore-6

FRESHLY harvested seeds of strawberry are in a state of dormancy and their rate of germination is extremely slow taking months to complete germination. Consequently, in addition to the total time lag, hybrid seedlings thus obtained from same crosses tend to be of different ages, complicating correct assessment. Although considerable work has been done to overcome the dormancy and to speed up the germination of strawberry seeds (Borgaman, 1950; Scott and Ink, 1955; Bringhurst and Voth, 1950; Adam and Wilson, 1967; Thompson, 1969), Thompson (1969) has rightly pointed out that most of the chemical treatments so far tried gave erratic results and could not replace the usual low temperature stratification. On the basis of his extensive studies, Thompson (1969) recommended stratification of strawberry seeds at 2° C. for 6 to 8 weeks which gave 80% germination within 14 days after sowing. This procedure would necessitate waiting for nearly 10 weeks from the time of extraction of achenes for obtaining hybrid seedlings. The present study was, therefore, taken up to find out more efficient and faster means for breaking the dormancy of strawberry seeds.

Fruits of the cultivar Gorella, introduced from Netherlands, were used for the seed germination study. The usual procedure of separating the seeds from the pulp by disintegration using a blender followed by decantation was employed. Three chemicals, namely, Gibberellic acid (25, 50 and 75 ppm), Thiourea (0·1 and 0·2%) and Ethrel (1,000, 2,500 and 5,000 ppm) were used in the study. Seeds were soaked for 24 hours in chemical solutions and distilled water for treatments and control respectively. These were washed with distilled water before they were sown in petri dishes on moist filter-paper kept at room temperature (20–22° C.). The filter-papers were kept moist by adding few drops of distilled water everyday. Three replications of 20 achenes were taken for each treatment. Visible emergence of the radicle was taken as the criterion of germination and counts were made everyday taking out the germinated achenes and planting them elsewhere.

The extent of germination under different treatments is given in Table I. The results show that, in general, all the chemical treatments stimulated seed germination as compared to control. However, the most outstanding results were obtained in case of seeds treated with Ethrel.

TABLE I

Effect of different chemical treatments on strawberry (e.v. Gorella) seed germination

Treatment	Concentration	Cumulative percentage of germination*					
		Within 5 days	Within 10 days	Within 15 days	Within 20 days	Within 25 days	Within 30 days
1. Control		..	..	5·0	10·0	10·0	20·0
2. Thiourea	0·1%	..	5·0	20·0	35·0	35·0	45·0
	0·2%	..	10·0	10·0	20·0	20·0	30·0
3. Gibberellic acid	25 ppm	..	5·0	15·0	25·0	25·0	25·0
	50 „	..	10·0	20·0	25·0	25·0	35·0
	75 „	..	10·0	10·0	30·0	30·0	30·0
4. Ethrel	1,000 „	..	10·0	15·0	20·0	30·0	30·0
	2,500 „	..	..	5·0	15·0	45·0	50·0
	5,000 „	..	45·0	65·0	70·0	70·0	90·0

* Data based on germination counts from three replications.

Pre-treatment with Ethrel at the three concentrations used, *viz.*, 1,000, 2,500 and 5,000 ppm induced 30, 50 and 90% germination respectively in a period of four weeks. At the highest concentration used, 45% of the seeds had germinated within ten days' time as compared to the control in which seeds did not germinate at all within this period.

---

* Contribution No. 37, Institute of Horticultural Research (ICAR), Hessaraghatta, Bangalore.

The growth-regulating properties of Ethrel (2-Chloroethane phosphonic acid) is known to be due to its ability to stimulate ethylene production in plant tissues (Edgerton and Blanpied, 1968). Earlier studies have revealed that ethylene is associated with the germination process of non-dormant seeds and participates in breaking of seed dormancy in dormant peanut varieties (Ketring and Morgan, 1969). Stimulation of seed germination and seedling growth by ethylene treatment have also been reported in a number of non-dormant seeds (Balls and Hale, 1940; Haber, 1926). However, it is not known from the present study whether the breaking of dormancy and subsequent early seedling emergence in strawberry seeds treated with Ethrel is due to the effect of ethylene released by the chemical in the seeds or due to some other unknown phenomenon. Extensive studies are under way to understand this point by using a number of ethylene-producing chemicals and also to investigate the effect of Ethrel and similar compounds on the content of abscisic acid present in strawberry fruits and seeds (Rudnick *et al.*, 1968) whose presence is generally correlated with seed dormancy (Lipe and Crane, 1966).

Considering the short period in which a high percentage of germination of strawberry seeds is obtained without adverse effects on the seedling establishment, a recommendation on the usage of Ethrel at 5,000 ppm can be made from the present study. This could obviously replace the low temperature stratification suggested by Thompson (1969), since the method proposed by the latter takes a total period of eight to ten weeks to obtain 80% germination in contrast to the procedure mentioned in the present studies which takes only four weeks, obtaining 90% germination.

The authors are grateful to Dr. G. S. Randhawa, Director, for his constant interest in this experiment and for encouragement. They wish to thank Amchem Products, Inc., for a gift sample of Ethrel used in the experiment.

---

1. Adam, J. and Wilson, D., "Factors affecting the germination of strawberry seed," *Rep. Long Ashton Res. Stn. for* 1966, 1967, p. 90.
2. Balls, A. K. and Hale, W. S., "The effect of ethylene on freshly harvested wheat," *Cereal Chemistry*, 1940, **17**, 490.
3. Borgman, H. H., "Die involved Van een Koudbehandeling op de kieming van aardbic 'Zaad'," *Meded Dir. Tuinb.*, 1950, **13**, 13.
4. Bringhurst, R. S. and Voth, V., "Effect of stratification on strawberry seed germination," *Proc. Am. Soc. Hort. Sci.*, 1957, **70**, 144.
5. Edgerton, L. J. and Blanpied, G. D., "Regulation of growth and fruit maturation with 2-chloroethane phosphonic acid," *Nature*, 1968, **219**, 1064.
6. Haber, E. S., "A preliminary report on the stimulation of growth of bulbs and seeds with ethylene," *Am. Soc. Hort. Sci.*, 1926, **23**, 201.
7. Ketring, D. L. and Morgan, P. W., "Ethylene gas as a component of emanations from germinating peanut seeds and its effect on dormant virgenia type seeds," *Pl. Physiol.*, 1969, **44**, 326.
8. Lipe, N. W. and Crane, J. C., "Dormancy regulation in peach seeds," *Science*, 1966, **153**, 541.
9. Rudnicki, R. J., Pieniazek and Piemiazek, V., "Abscisio 11 in strawberry plants at two different stages of growth," *Bull. De L' Academic Polonaise Des Sciences*, 1968, Cl. V, **16** (2), 127.
10. Scott, D. H. and Ink, D. P. "Treatments to hasten the emergence of seedlings of blueberry and strawberry," *Proc. Am. Soc. Hort. Sci.*, 1955, **66**, 237.
11. Thompson, P. A., "The use of chilling and chemical treatments to promote rapid germination of strawberry achenes," *J. Hort., Sci.*, 1969, **44**, 201.

THE DISPUTED 2·86 MeV LEVEL OF B^{10}

M. L. SRIVASTAVA AND J. P. SAH
Department of Physics, Lucknow University, Lucknow-7, India

THE energy spectrum of neutrons from $Be^9(d, n)$ B^{10} has been investigated by many workers. Evidence has been produced for energy levels of B^{10} at excitations of 0·72, 1·74, 2·15 and 3·58 MeV besides the ground state. Many contradictory reports concerning the possible existence of a level at 2·86 MeV in B^{10} have been published since Dyer and Bird (1953) presented evidence for such a level from a study of the above reaction using nuclear emulsions. Again using the emulsion as detector this level was not reported by Green *et al.* (1955) and Shpetnyi *et al.* (1957).

The 2·86 MeV level has been suggested by Galloway and Sillitto (1961) using γ-ray coincidence and by Coombe and Walker (1962) using Diffusion Chamber as detector. Following the time of flight method for coincident γ-rays Neilson *et al.* (1958) and Maydan and Vass (1965) found no indication of this level. The neutron spectrometer experiment of Siemsses *et al.* (1965) also led to the same result while the same experiment performed by Reid (1954) had produced evidence for the 2·86 MeV level.

In view of this conflicting evidence it was thought that a further investigation of the level scheme of B^{10} using a modified procedure (Sah, 1965) for scanning the photographic emulsions would be useful.

A Be target (200 μ gm./cm.^{2}) supported by 3/16″ copper backing was bombarded with 650 + 5 KeV deuterons from the Cockcroft and Walton generator of the Tata Institute of Fundamental Research, Bombay. The outgoing neutrons were detected by 200 μ Ilford K 2 nuclear research plates (7·62 cm. × 2·54 cm.) held radially at a distance of 15·10 cm. from the target at angles of 0°, 90° and 150° to the direction of the deuteron beam. After irradiation the plates were processed using the method of temperature development.

The plates were examined on a Cooke Troughton and Simms Nuclear Research Microscope and the modified procedure for scanning (Sah, 1965) was followed.

A total of 3,000 proton recoil tracks were recorded at 0°, 90° and 150°. Only 9 tracks ran out of the emulsions.

The energy corresponding to the measured ranges of the recoil protons was obtained from the range energy relation given by Wilkins (1951). After necessary corrections, the data at each angle were collected in the form of a histogram where the number of tracks were plotted against the neutron energy in intervals of 100 KeV. The neutron energy spectra for 0° and 90° are shown in Figs. 1 and 2.

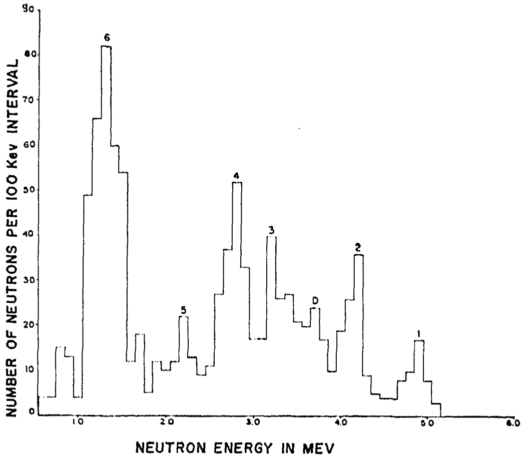


FIG. 1. Neutron energy spectrum at 0°.

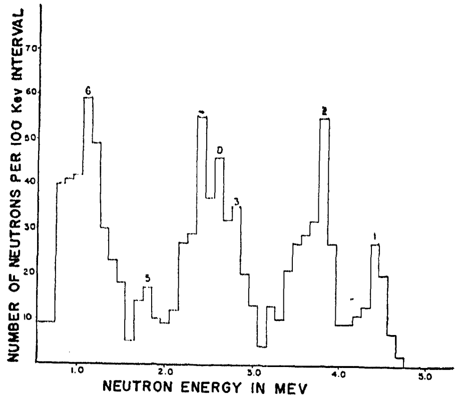


FIG. 2. Neutron energy spectrum at 90°.

Result.—In Figs. 1 and 2, the six neutron groups numbered 1 to 6 correspond to the formation of B^{10} at different excitation energies. The neutron group from the D-D reaction has been marked D on the histograms.

TABLE I

Q-values in MeV at the different angles for the energy levels of B^{10}

Angle \ Neutron group		1	2	3	4	5	6
0°	..	4·37±0·11	3·62±0·10	2·59±0·08	2·18±0·06	1·56±0·10	0·65±0·05
90°	..	4·32±0·10	3·66±0·06	2·56±0·06	2·12±0·05	1·46±0·11	0·69±0·09
150°	..	4·39±0·09	3·60±0·06	2·66±0·08	2·20±0·06	1·50±0·07	0·66±0·09

The Q-values for the various levels of B^{10} at the different angles have been tabulated in Table I along with the probable error. The Q-value for transition to the ground state 4·36 ± 0·1 MeV is in good agreement with the value of 4·36 MeV reported by Ajzenberg *et al.* (1959) from recent nuclear masses.

Evidence has thus been produced for levels in B^{10} at excitations of 0·73, 1·76, 2·19, 2·85 and 3·69 MeV besides the ground state. The neutron group corresponding to the 2·85 MeV level is clearly resolved. Further evidence for this level is being sought from plates at angles of 45°, 60°, 120° and 135° which are now being scanned.

---

1. Coombe, R. A. and Walker, J., *Proc. Phys. Soc.*, 1962, **80**, 1218.
2. Dyer, A. J. and Bird, J. R., *Aust. J. Phys.*, 1953, **6**, 45.
3. Galloway, R. B. and Sillitto, R. M., *Proc. Roy. Soc. Edinb.*, 1961, **65 A**, 247.
4. Green, L. L., Scanlon, J. P. and Willmot, J. C., *Proc. Phys. Soc.*, 1955, **68 A**, 387.
5. Maydan, D. and Vass, D. G., *Ibid.*, 1965, **86**, 817.
6. Neilson, G. E., Dawson, W. K. and Sample, J. T., *Bull. Am. Phys. Soc.*, 1958, **3**, 323
7. Reid, G. C., *Proc. Phys. Soc.*, 1954, **67 A**, 466.
8. Sah, J. P., *Indian J. Phys.*, 1965, **39**, 193.
9. Shpetnyi, A. I., *Soviet Physics*, J.E.T.P., 1957, **5**, 357.
10. Siemsses, R. H., Coseck, M. and Flest, R., *Nuclear Phys.*, 1965, **69**, 209.

INCREASED EFFICIENCY OF TREATMENTS WITH ETHYL METHANE SULPHONATE ADMINISTERED UNDER PRESSURE

Y. S. NERKAR, E. A. SIDDIQ AND R. P. PURI

Nuclear Research Laboratory, I.A.R.I., New Delhi

SEVERAL chemical mutagens have proved rather effective in barley and wheat but not in rice presumably because of the hull or the inability of the chemical to penetrate the water-resistant corky layer of the bran.[1] The seedcoat barrier in rice was overcome by using dehulled seeds suitably treated with effective fungicides such as captan.[2] Further studies on the effect of dehusking on mutation frequency also revealed that treatments with mutagens, chemicals in particular, showed an enhanced mutation frequency in dehusked seeds.[3] By getting the seeds into a metabolically active state by presoaking for longer periods, Mikaelsen and Navaratna[1] could enhance treatment efficiency. Experiments on the use of the chemical carrier di-methyl sulphoxide in combination with chemical mutagens and colchicine revealed that the cell permeability is enhanced by the treatment in rice and barley.[4,5] The present report gives the results of treatments of seeds with chemical mutagens under varied pressure levels.

Seeds of the *japonica* rice variety, Tainan 3, presoaked in water for four hours were treated with 0·5% aqueous solution of EMS for five hours under pressure levels ranging from vacuum to 20 atmospheres (including normal atmosphere). Another set soaked in water and subjected to the same range of pressure levels was kept as control.

The material thus treated was germinated under controlled light and temperature. The effects of treatments were measured by percentage reduction of survival and growth rate. The results are presented in Figs. 1, 2 and 3.

It is evident from the data that treatment with EMS under different pressure levels invariably showed more reduction in survival and growth rate than treatments under normal pressure level. Further, the data indicated

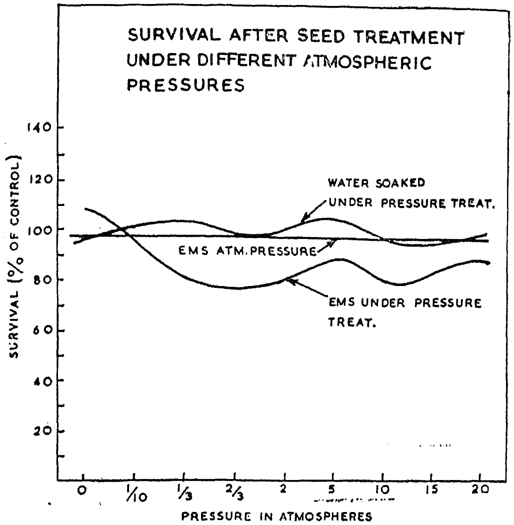


FIG. 1

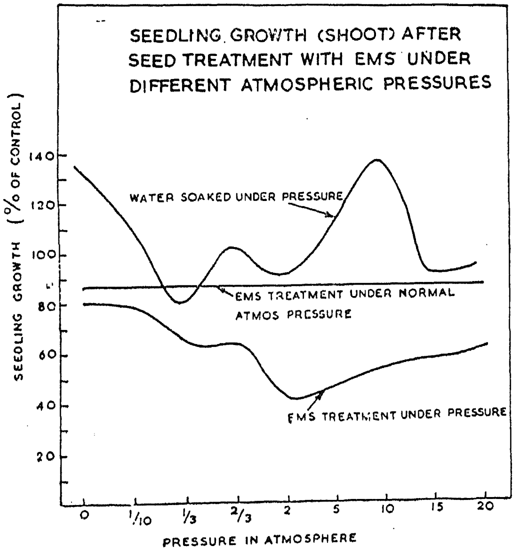


FIG. 2

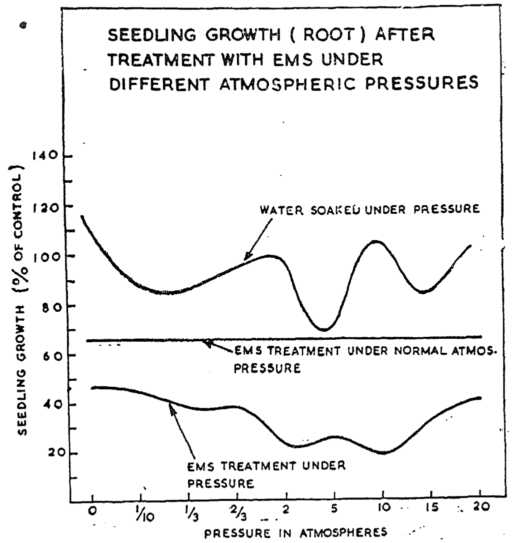


FIG. 3

that there was a gradual increase in the seedling injury from vacuum to 2 atmospheres in the case of shoot and 2 to 10 in root. Beyond this level, the injury became lower. A non-linear dose dependent response observed in the present case appears to be similar to the observation of Moutschen-Dahmen *et al.*[6] in their study on the mutagenic effect of oxygen at different pressure levels. In the absence of oxygen, the influence of pressure during treatment with the chemical mutagen seems to be a physical phenomenon, as a result of enhanced permeability of cell membrane facilitating the entry of the chemical with ease.

The data further suggested that there was enhanced growth rate and survival over control at certain levels of pressure and decreased rates at others in water-soaked seeds, presumably as a result of the influence of pressure on the growth-promoting principles which in turn affected cell volume. Whatever be the factors responsible for the non-linear response to dose, it appears that diffusion of chemical mutagens into the tissue could be achieved by administering the mutagen treatment at standardised pressure levels.

We gratefully record our thanks to Dr. M. S. Swaminathan, Director, I.A.R.I., for his valuable suggestions and Dr. T. D. Biswas, Professor of Soil Science, and his colleague Mr. Naskar for providing necessary facilities to carry out this work.

---

1. Mikaelsen, K. and Navaratna, S. K., *Symposium on the Use of Induced Mutations in Rice Breeding*, IAEA, Vienna, 1968, p 127.
2. Siddiq, E. A. and Swaminathan, M. S., *Ibid.*, p. 25.
3. Swaminathan, M. S., Siddiq, E. A., Singh, C. B. and Pai, R. A, *Proc. 4th Co-ordinating Meeting of the FAO/IAEA Co-ordinated Programme on the Use of Induced Mutations in Rice Breeding*, 1968.
4. Siddiq, E. A., Puri, R. P. and Singh, V. P., *Curr. Sci.*, 1961, **37** (24), 686.
5. — and Majid, R., *Ibid.*, 1968, **38** (8), 215.
6. Moutschen-Dahmen, M., Moutschen, J. and Ehren, Berg, L., *Seport Ur Hereditas*, 1959, **45**, 230,

LETTERS TO THE EDITOR

STUDIES OF HYDROGEN BONDING IN COMPLEXES OF METHANOL AND PARACHLOROPHENOL WITH TERTIARY THIOAMIDES

PROTON magnetic resonance and infrared spectroscopic studies of solvent-solute interactions in methanol with some tertiary amides[1,2] have been recently undertaken with a view to investigate the strength of the H-bond interaction in these complexes. The frequency differences between the free and bonded OH stretching absorption bands in methanol-dimethylamide complexes are higher than those in methanol-diphenylamide complexes. This is due to the competitive effect of the phenyl ring for the lone pair of electrons on the nitrogen atom with the result that the mixing of the π-orbitals of the C=O group and $2P_Z$ orbital of nitrogen atom is lessened resulting in the reduction of the polarity of the C=O bond in diphenylamides.

The authors have extended these results to study the spectral changes of the O-H stretching absorption bands of methanol-thioamide and parachlorophenol-thioamide complexes and compare these results with those of ordinary tertiary amide complexes with methanol and parachlorophenol. These results are of special interest especially in view of the fact that the hydrogen bond of S...H type is known to be a weak bond.

The infrared spectra of OH stretching absorption band of methanol or parachlorophenol in CCl_4 and the tertiary-thioamides were recorded with Perkin Elmer Model 221 infrared spectrophotometer using matched quartz cells of 3 cm. thickness. The thioamides used are N, N dimethylthioformamide and N, N dimethylthioacetamide. Dilute solutions of methanol or parachlorophenol in CCl_4 were used so as to eliminate intermolecular associations. The spectra were recorded with (*i*) methanol or parachlorophenol in CCl_4 in the sample beam with CCl_4 in the reference beam, and (*ii*) methanol or parachlorophenol in CCl_4 in the presence of the thioamide in the sample beam with the thioamide of same concentration in CCl_4 in reference beam. The spectra of the OH stretching absorption band of methanol in CCl_4 and in the presence a dimethyl amide, diphenylamide and dimethylthioamide are given in Fig. 1. The corresponding free and bonded OH stretching frequencies of methan and parachlorophenol in the presence of th dimethylthioamides and other amides are give in Tables I and II.

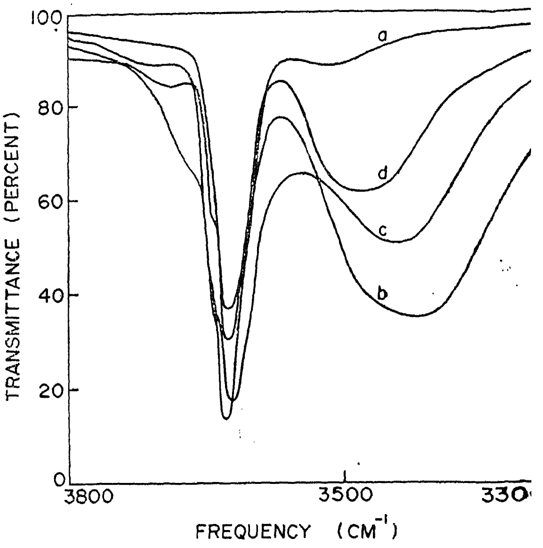


FIG. 1. (*a*) OH stretching band of methanol in CCl (*b*) OH stretching band of methanol in CCl_4 in t presence of dimethylacetamide. (*c*) OH stretching ba of methanol in CCl_4 in the presence of dimethylthi acetamide. (*d*) OH stretching band of methanol in CC in the presence of diphenylacetamide.

TABLE I

OH stretching frequencies (in cm.$^{-1}$) in methanol-amide complexes

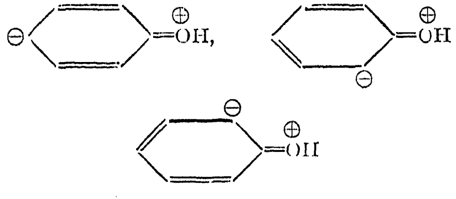
Amide	Molar conc. of		OH stretching frequency		
	Methanol	Amide	Free (ν)	Bonded (ν')	$\Delta\nu = \nu - \nu'$
Dimethylformamide	0·01	0·05	3628	3459	16
Dimethylthioformamide	0·01	0·10	3628	3465	16
Diphenylformamide	0·008	0·04	3628	3512	11
Dimethylacetamide	0·01	0·05	3628	3431	19
Dimethylthicacetamide	0·01	0·10	3628	3447	18
Diphenylacetamide	0·008	0·04	3628	3481	14

Three important results emerge out of thes experimental results. The frequency differen between free and bonded OH stretching fre quencies of methanol and parachlorophenol i

TABLE II
OH stretching frequencies (in cm.$^{-1}$) in parachlorophenol-amide complexes

Amide	Molar conc. of		OH stretching frequency		$\Delta\nu = \nu - \nu'$
	Para-chloro-phenol	Amide	Free (ν)	Bonded (ν')	
Dimethylformamide	0·005	0·01	3578	3275	303
Dimethylthioformamide	0·005	0·025	3578	3284	294
Diphenylformamide	0·005	0·01	3578	3365	213
Dimethylacetamide	0·005	0·01	3578	3219	359
Dimethylthioacetamide	0·005	0·025	3578	3259	319
Diphenylacetamide	0·005	0·01	3578	3303	275

the presence of the various amides is considerable, varying from 116 cm.$^{-1}$ to 359 cm.$^{-1}$ indicating that the H-bond interaction in these complexes is considerably strong. This is because of the fact that two possible structures contribute to the resonance hybrid in amides with the dipolar resonance structure making substantial contribution increasing the polarity of the C=O or C=S bond. For a given amide, the frequency difference between the free and bonded OH stretching frequencies is more in parachlorophehol than in methanol and this is due to the contribution of the structures to the



ground state of parachlorophenol increasing the ionic character of OH bond in it. Although the S...H hydrogen bonding is known to be a weak bond, the frequency difference between the free and bonded OH stretching frequencies in methanol-thioamide complexes or parachlorophenol-thioamide complexes are only slightly lower than those of the complexes with ordinary dimethylamides and are much higher than those with the diphenylamides. These results indicate that the S...H bond in complexes with thioamides is strong indicating that the polarity of the C=S bond in thioamides is considerable. Due to the relatively low electronegativity of the sulphur compared to that of the oxygen atom, the interaction between the π-orbitals of C=S group and the $2P_z$ orbital of nitrogen atom may be considerable in thioamides. This results in the increased ionic character of the C=S group and is responsible for strong H-bond formation in methanol-thioamide and parachlorophenol-thioamide complexes.

Post-Graduate Centre, K. VENKATA RAMIAH.
Warangal-1 (A.P.);
Dept. of Physics, C. A. INDIRA CHARY.
Osmania University,
Hyderabad-7 (A.P.), *January* 5, 1970.

---

1. Kanekar, C. L., Khetrapal, K., Venkata Ramiah, K. and Indira Chary, C. A., *Proc. Ind. Acad. Sci.*, 1967, **66**, 189.
2. Venkata Ramiah, K. and Indira Chary, C. A., *Curr. Sci.*, 1968, **37**, 130.

QUANTITATIVE SEPARATION OF CADMIUM (OR LEAD) FROM CALCIUM AND PHOSPHATE

THE need for rapid and accurate quantitative separations of Cd^{2+}, Ca^{2+} and PO_4^{3-} and Pb^{2+}, Ca^{2+} and PO_4^{3-} was felt for a study of the kinetics of $Ca^{2+} \rightleftharpoons Cd^{2+}$ and $Ca^{2+} \rightleftharpoons Pb^{2+}$ exchange reactions on hydroxylapatite, $3Ca_3(PO_4)_2 \cdot Ca(OH)_2$, the principal inorganic constituent of human bones and teeth. The present communication has been an attempt to arrive at optimum conditions for such separations and to investigate the suitability of complexometric titrations for the subsequent quantitative determinations.

Cadmium (or lead) was first precipitated as sulphide[1] and from the filtrate calcium and phosphate were separated by the method of Washburn and Shear[2] as calcium oxalate and magnesium ammonium phosphate respectively. The precipitates of cadmium, calcium and phosphate were separately dissolved in hydrochloric acid while that of lead was dissolved in nitric acid. The cationic concentrations of these solutions were determined complexometrically. The solutions were prepared in double distilled water which was collected and preserved in polyethylene bottles and tested for the absence of Ca^{2+}. The chemicals used were of A.R. (BDH) grade.

Procedure.—To a convenient volume of a sample solution containing known amounts of cadmium (or lead), calcium and phosphate (*see* Tables I and II) an equal volume of ~ 6·0 M acetic acid was added followed by the dropwise addition of ~1·0 M sodium sulphide solution till there was no further precipitation of the sulphide from the supernatant liquid. The precipitate was boiled with the mother-

TABLE I

Quantitative separation of Cd^{2+}, Ca^{2+} *and* PO_4^{3-}

Trial No.	Cadmium			Calcium			Phosphorus		
	Wt. (mg.)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo	Exptl.	
I	49·900	49·780	0·24	48·096	48·096	0·00	46·530	46·240	0·60
II	62·375	62·225	0·24	60·120	60·006	0·20	55·836	55·836	0·00

TABLE II

Quantitative separation of Pb^{2+}, Ca^{2+} *and* PO_4^{3-}

Trial No.	Lead			Calcium			Phosphorus		
	Wt. (mg)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo.	Exptl.	
I	62·150	61·750	0·66	48·096	48·096	0·00	24·816	24·816	0·00
II	82·876	82·470	0·50	60·120	60·000	0·20	31·020	31·020	0·00

liquor for ~ 5 min. filtered through a 1G4 crucible, washed repeatedly with ~ 0·05 M solution of sodium sulphide, the washings being added to the filtrate. Cadmium sulphide was dissolved in minimum volume of ~ 5·0 M hydrochloric acid (nitric acid in the case of lead sulphide), which was heated to boiling. The solutions were made up to known convenient volumes. 10 ml. of the cadmium solution were titrated against standard 0·01 M EDTA at a pH ~ 10 using Eriochrome Black T as indicator till a sharp colour change from wine-red to blue occurred. 10 ml. of lead solution were treated with an excess of standard 0·01 M EDTA, the excess being back-titrated at a pH ~ 10 against standard 0·01 M magnesium sulphate solution using Eriochrome Black T as indicator till there was a sharp colour change from blue to wine-red. The presence of the excess of EDTA in the solution to be titrated can be confirmed by the formation of the blue colour on the addition of the indicator.

The filtrate was boiled to drive off hydrogen sulphide, its calcium and phosphate contents being determined complexometrically as described earlier.[3]

Representative sets of the results are given in Tables I and II. The method suggested was found to be rapid and accurate. It can be extended to the quantitative separation of calcium and phosphate from any metal which forms an insoluble sulphide in the acidic medium, appropriate conditions being adopted for the dissolution of the sulphide for the subsequent complexometric determination.

The authors are thankful to Prof. G. B. Singh, Head of the Chemistry Department, Banaras Hindu University, for providing facilities. Financial assistance given to one of us (RPS) by CSIR (India) is gratefully acknowledged.

Chemistry Department, T. S. B. NARASARAJU.
Banaras Hindu Univ., R. P. SINGH.
Banaras (India), *December* 16, 1969.

---

1. Salaria, G. B. S., *Anal Chem. Acta*, 1958, **19**, 244.
2. Washburn, M. L. and Shear, M. J., *J. Biol. Chem.*, 1932, **99**, 12; cf. *Z. Anal. Chem.*, 1934, **98**, 53.
3. Singh, R. P., Chickerur, N. S. and Narasaraju, T. S. B., *Ibid.*, 1968, **237**, 117.

SYNTHESIS OF SOME HYDRAZONES

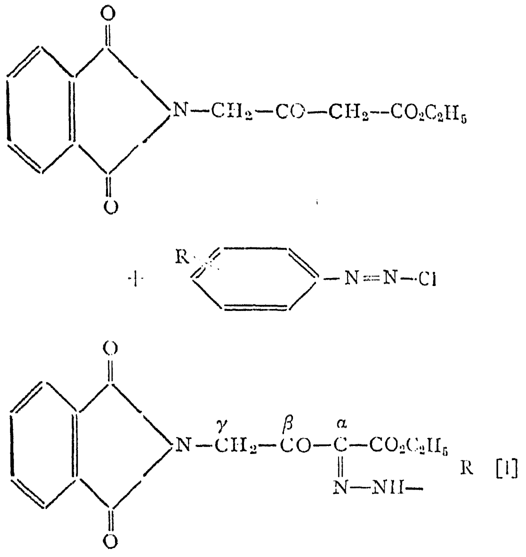
WE wish to report the synthesis of some hydrazones which have been prepared by the coupling of diazonium salt of arylamine with phthalmido acetoacetic ester. Coupling took place at the reactive methylene group, thus giving rise to the desired hydrazone. These compounds could exist either in the azo or in the hydrazone form. Wiley and Jarboe[1] have established by IR and UV data that the hydrazone form is more stable. It has also been confirmed by the coupling of acetoacetic ester with amines that the products obtained were the α-hydrazones,[2-4] and not the azo compounds.

The following route to the formation of ethyl-γ-phthalmido-α-β-dioxobutrate-α-phenyl hydrazone (I) was adopted. A solution of 2·3 g. (0·03 mol.) of sodium nitrite in 8 ml. of water was added slowly below the

TABLE I

Amines	Products formed (mol. formula)	M.P.*	Colour	Yield (%)	Elemental analyses (%)					
					Carbon		Hydrogen		Nitrogen	
					F	C	F	C	F	C
Aniline ..	$C_{21}H_{19}O_5N_3$	140°	Yellow	66	63·2	63·3	4·5	4·4	11·0	11·1
o-Nitroaniline ..	$C_{20}H_{16}O_7N_3$	205°	Yellow	65	56·5	56·6	3·6	3·7	13·1	13·2
m-Nitroaniline ..	$C_{20}H_{16}O_7N_3$	208°	Pale yellow	80	56·4	56·6	3·4	3·7	13·0	13·2
p-Nitroaniline ..	$C_{20}H_{16}O_7N_3$	220°	Yellow	70	56·5	56·6	3·5	3·7	13·0	12·2
p-Toludine ..	$C_{21}H_{19}O_5N_3$	140°	Red	40	63·9	64·1	4·8	4·8	10·8	10·7
p-Amino benzene-sulfonamide	$C_{21}H_{20}O_7N_4S$	125°	Light green	60	53·1	53·3	4·2	4·2	11·9	11·8

* All melting points are uncorrected. F = Found ; C = Calculated.



[R = H, $-NO_2$ (*o*–, –*m*, and –*p*), $-CH_3$, $-SO_2NH_2$]

surface of a cold, well-stirred solution of 3·1 g. (0·03 mol.) of aniline in 8 ml. of concentrated hydrochloric acid. The temperature of the solution was kept at 0–5° C. during addition. After ten minutes the solution was made alkaline to congo red by the addition of sodium acetate solution. The diazonium solution was added drop by drop with stirring to a cold solution of 9·1 g. (0·03 mol.) of phthalmido acetoacetic ester, 8·2 g. (0·1 mol.) of sodium acetate, 50 ml. of water and 250 ml. of acetone. The temperature was maintained below 10° during the addition. The mixture was stirred for a further thirty minutes at room temperature, then 100 ml. of water was added before the yellow solid was filtered. The yield of the solid obtained was found to be 8·0 g. (66%) and the melting point 140° C. The solid may be recrystallized by ethyl acetate.

Melting points and analytical data of the hydrazones prepared are listed in Table. I.

The authors are thankful to Professor R. A. Srivastava for providing the necessary facilities.

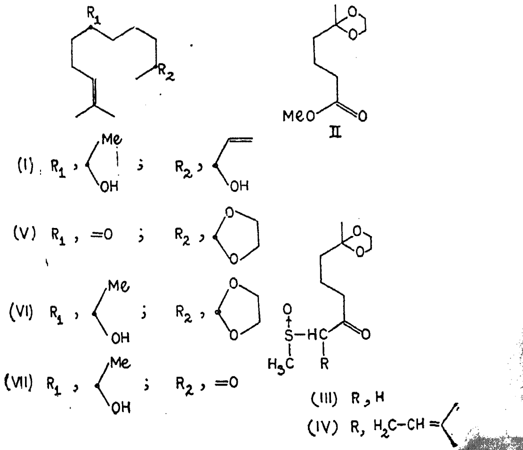
Chemical Laboratories, R. K. SAKSENA.
D.A.V. College, S. D. VERMA.
Kanpur, *December* 4, 1969.

---

1. Wiley and Jarboe, *J. Am. Chem. Soc.*, 1955, **77**, 403.
2. Bulow and Neber, *Ber.*, 1908, **45**, 3732.
3. Goldberg and Kelly, *J. Chem. Soc.*, 1948, p. 1919.
4. Chattway and Ashworth, *Ibid.*, 1933, p. 475.

A SYNTHESIS OF CAPPARAPIDIOL

As a part of our investigations towards the syntheses of terpenoids through β-keto-sulphoxide as the key intermediate, we report in the present communication a synthesis of structure (I) assigned to capparapidiol, a sesquiterpene diol isolated[1] from 'capparap' oil.



Methyl 5, 5-ethylenedioxy-hexanoate (II) prepared by ketalising[2] methyl

TABLE I

Quantitative separation of Cd^{2+}, Ca^{2+} and PO_4^{3-}

Trial No.	Cadmium			Calcium			Phosphorus		
	Wt. (mg.)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo	Exptl.	
I	49·900	49·780	0·24	48·096	48·096	0·00	46·530	46·240	0·60
II	62·375	62·225	0·24	60·120	60·006	0·20	55·836	55·836	0·00

TABLE II

Quantitative separation of Pb^{2+}, Ca^{2+} and PO_4^{3-}

Trial No.	Lead			Calcium			Phosphorus		
	Wt. (mg)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo.	Exptl.	
I	62·150	61·750	0·66	48·096	48·096	0·00	24·816	24·816	0·00
II	82·876	82·470	0·50	60·120	60·000	0·20	31·020	31·020	0·00

liquor for $\sim$ 5 min. filtered through a 1G4 crucible, washed repeatedly with $\sim$ 0·05 M solution of sodium sulphide, the washings being added to the filtrate. Cadmium sulphide was dissolved in minimum volume of $\sim$ 5·0 M hydrochloric acid (nitric acid in the case of lead sulphide), which was heated to boiling. The solutions were made up to known convenient volumes. 10 ml. of the cadmium solution were titrated against standard 0·01 M EDTA at a pH $\sim$ 10 using Eriochrome Black T as indicator till a sharp colour change from wine-red to blue occurred. 10 ml. of lead solution were treated with an excess of standard 0·01 M EDTA, the excess being back-titrated at a pH $\sim$ 10 against standard 0·01 M magnesium sulphate solution using Eriochrome Black T as indicator till there was a sharp colour change from blue to wine-red. The presence of the excess of EDTA in the solution to be titrated can be confirmed by the formation of the blue colour on the addition of the indicator.

The filtrate was boiled to drive off hydrogen sulphide, its calcium and phosphate contents being determined complexometrically as described earlier.[3]

Representative sets of the results are given in Tables I and II. The method suggested was found to be rapid and accurate. It can be extended to the quantitative separation of calcium and phosphate from any metal which forms an insoluble sulphide in the acidic medium, appropriate conditions being adopted for the dissolution of the sulphide for the subsequent complexometric determination.

The authors are thankful to Prof. G. B. Singh, Head of the Chemistry Department, Banaras Hindu University, for providing facilities. Financial assistance given to one of us (RPS) by CSIR (India) is gratefully acknowledged.

Chemistry Department, T. S. B. NARASARAJU.
Banaras Hindu Univ., R. P. SINGH.
Banaras (India), *December* 16, 1969.

---

1. Salaria, G. B. S., *Anal Chem. Acta*, 1958, **19**, 244.
2. Washburn, M. L. and Shear, M. J., *J. Biol. Chem.*, 1932, **99**, 12; cf. *Z. Anal. Chem.*, 1934, **98**, 53.
3. Singh, R. P., Chickerur, N. S. and Narasaraju, T. S. B., *Ibid.*, 1968, **237**, 117.

SYNTHESIS OF SOME HYDRAZONES

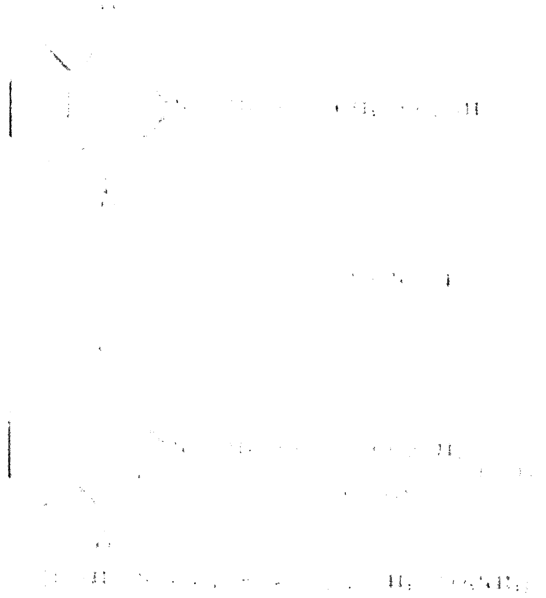
WE wish to report the synthesis of some hydrazones which have been prepared by the coupling of diazonium salt of arylamine with phthalmido acetoacetic ester. Coupling took place at the reactive methylene group, thus giving rise to the desired hydrazone. These compounds could exist either in the azo or in the hydrazone form. Wiley and Jarboe[1] have established by IR and UV data that the hydrazone form is more stable. It has also been confirmed by the coupling of acetoacetic ester with amines that the products obtained were the α-hydrazones,[2-4] and not the azo compounds.

The following route to the formation of ethyl-γ-phthalmido-α-β-dioxobutrate-α-phenyl hydrazone (I) was adopted. A solution of 2·3 g. (0·03 mol.) of sodium nitrite in 8 ml. of water was added slowly below the

TABLE I

[illegible]	[illegible]	m.p.*	[illegible]	Yield (%)	Elemental analyses (%)					
					Carbon		Hydrogen		Nitrogen	
					F	C	F	C	F	C
[illegible]	[illegible]	140°	Yellow	66	63·2	63·3	4·5	4·1	11·0	11·1
[illegible]	[illegible]	265°	Yellow	[illegible]	56·5	56·6	3·6	3·7	13·1	13·2
[illegible]	[illegible]	268°	Pale yellow	80	56·4	56·6	3·4	3·7	13·0	13·2
[illegible]	[illegible]	220°	[illegible]	70	56·5	56·6	3·5	3·7	13·0	12·2
[illegible]	[illegible]	140°	[illegible]	40	63·9	64·1	4·8	4·8	10·8	10·7
[illegible]	[illegible]	127°	[illegible]	60	53·1	53·3	4·2	4·2	11·9	11·8

* [illegible] F = Found, C = Calculated.



[illegible] solution of 3·1 g [illegible] in 30 ml of con[illegible] [illegible] addition [illegible] was made [illegible] of sodium acetate [illegible] solution of [illegible] phthalimido [illegible] of sodium acetate [illegible] of water and [illegible] of acetone. The temperature was [illegible] below [illegible] during the addition. The reaction was stirred for a further three minutes at room temperature, then [illegible] of water was added before the yellow solid was filtered. The yield of the solid obtained was found to be 8·0 g (66%) and the melting point 140° C. The solid may be recrystallized by ethyl acetate.

Melting points and analytical data of the [illegible] prepared are listed in Table I.

The authors are thankful to Professor R. A. [illegible] for providing the necessary facilities.

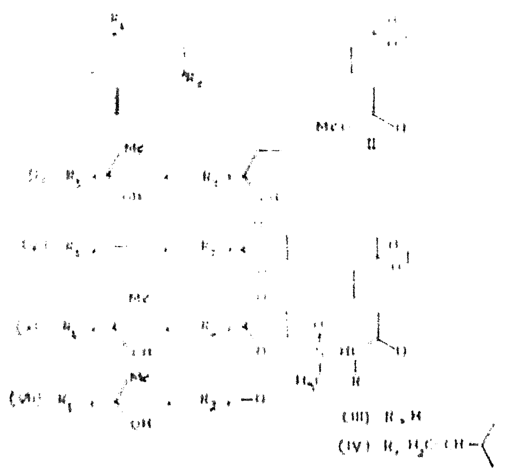
Chemical Laboratories, R. K. SAKSENA.
D.A.V. College, S. D. VERMA.
Kanpur, December 4, 1969.

---

1. Wiley and [illegible], J. Am. Chem. Soc., 1955, 77, 403.
2. [illegible] and [illegible], Ber., 1908, 45, 3732.
3. Goldberg and Kelly, J. Chem. Soc., 1948, p. 1919.
4. Chattaway and Ashworth, Ibid., 1933, p. 475.

A SYNTHESIS OF CAPPARAPIDIOL

As a part of our investigations towards the synthesis of terpenoids through β-keto sulphoxide as the key intermediate, we report in the present communication a synthesis of [illegible] assigned to capparapidiol, a sesquiterpenic diol isolated[1] from 'capparap' oil.



Methyl 5,5-ethylenedioxy-hexanoate (II) was prepared by ketalising[2] methyl 5-oxo-

TABLE I

Quantitative separation of Cd^{2+}, Ca^{2+} and PO_4^{3-}

Trial No.	Cadmium			Calcium			Phosphorus		
	Wt. (mg.)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo	Exptl.	
I	49·900	49·780	0·24	48·096	48·096	0·00	46·530	46·240	0·60
II	62·375	62·225	0·24	60·120	60·006	0·20	55·836	55·836	0·00

TABLE II

Quantitative separation of Pb^{2+}, Ca^{2+} and PO_4^{3-}

Trial No.	Lead			Calcium			Phosphorus		
	Wt. (mg)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo.	Exptl.	
I	62·150	61·750	0·66	48·096	48·096	0·00	24·816	24·816	0·00
II	82·876	82·470	0·50	60·120	60·000	0·20	31·020	31·020	0·00

liquor for ~ 5 min. filtered through a 1G4 crucible, washed repeatedly with $\sim 0{\cdot}05$ M solution of sodium sulphide, the washings being added to the filtrate. Cadmium sulphide was dissolved in minimum volume of $\sim 5{\cdot}0$ M hydrochloric acid (nitric acid in the case of lead sulphide), which was heated to boiling. The solutions were made up to known convenient volumes. 10 ml. of the cadmium solution were titrated against standard 0·01 M EDTA at a pH $\sim$ 10 using Eriochrome Black T as indicator till a sharp colour change from wine-red to blue occurred. 10 ml. of lead solution were treated with an excess of standard 0·01 M EDTA, the excess being back-titrated at a pH $\sim$ 10 against standard 0·01 M magnesium sulphate solution using Eriochrome Black T as indicator till there was a sharp colour change from blue to wine-red. The presence of the excess of EDTA in the solution to be titrated can be confirmed by the formation of the blue colour on the addition of the indicator.

The filtrate was boiled to drive off hydrogen sulphide, its calcium and phosphate contents being determined complexometrically as described earlier.[3]

Representative sets of the results are given in Tables I and II. The method suggested was found to be rapid and accurate. It can be extended to the quantitative separation of calcium and phosphate from any metal which forms an insoluble sulphide in the acidic medium, appropriate conditions being adopted for the dissolution of the sulphide for the subsequent complexometric determination.

The authors are thankful to Prof. G. B. Singh, Head of the Chemistry Department, Banaras Hindu University, for providing facilities. Financial assistance given to one of us (RPS) by CSIR (India) is gratefully acknowledged.

Chemistry Department, T. S. B. NARASARAJU.
Banaras Hindu Univ., R. P. SINGH.
Banaras (India), *December* 16, 1969.

---

1. Salaria, G. B. S., *Anal Chem. Acta*, 1958, **19**, 244.
2. Washburn, M. L. and Shear, M. J., *J. Biol. Chem.*, 1932, **99**, 12; cf. *Z. Anal. Chem.*, 1934, **98**, 53.
3. Singh, R. P., Chickerur, N. S. and Narasaraju, T. S. B., *Ibid.*, 1968, **237**, 117.

SYNTHESIS OF SOME HYDRAZONES

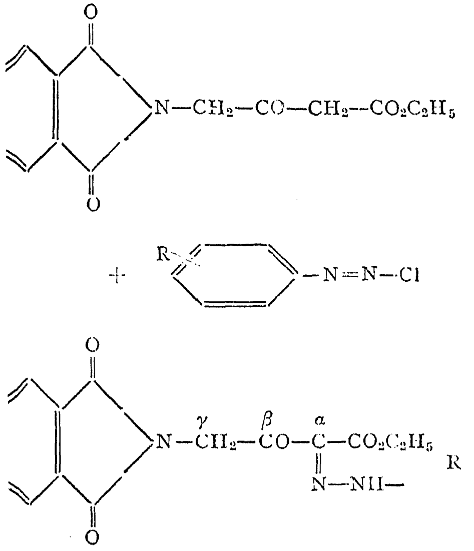
WE wish to report the synthesis of some hydrazones which have been prepared by the coupling of diazonium salt of arylamine with phthalmido acetoacetic ester. Coupling took place at the reactive methylene group, thus giving rise to the desired hydrazone. These compounds could exist either in the azo or in the hydrazone form. Wiley and Jarboe[1] have established by IR and UV data that the hydrazone form is more stable. It has also been confirmed by the coupling of acetoacetic ester with amines that the products obtained were the α-hydrazones,[2-4] and not the azo compounds.

The following route to the formation of ethyl-γ-phthalmido-α-β-dioxobutrate-α-phenyl hydrazone (I) was adopted. A solution of 2·3 g. (0·03 mol.) of sodium nitrite in 8 ml. of water was added slowly below the

TABLE I

Amines		Products formed (mol. formula)	M.P.*	Colour	Yield (%)	Elemental analyses (%)					
						Carbon		Hydrogen		Nitrogen	
						F	C	F	C	F	C
niline	..	$C_{21}H_{19}O_5N_3$	140°	Yellow	66	63·2	63·3	4·5	4·4	11·0	11·1
Nitroaniline	..	$C_{20}H_{16}O_7N_3$	205°	Yellow	65	56·5	56·6	3·6	3·7	13·1	13·2
-Nitroaniline	..	$C_{20}H_{16}O_7N_3$	208°	Pale yellow	80	56·4	56·6	3·4	3·7	13·0	13·2
-Nitroaniline	..	$C_{20}H_{16}O_7N_3$	220°	Yellow	70	56·5	56·6	3·5	3·7	13·0	12·2
-Toludine	..	$C_{21}H_{19}O_5N_3$	140°	Red	40	63·9	64·1	4·8	4·8	10·8	10·7
Amino benzene-sulfonamide		$C_{21}H_{20}O_7N_4S$	125°	Light green	60	53·1	53·3	4·2	4·2	11·9	11·8

* All melting points are uncorrected. F=Found ; C=Calculated.



[I]

[R=H, $-NO_2$ (*o*–, –*m*, and –*p*), $-CH_3$, $-SO_2NH_2$]

urface of a cold, well-stirred solution of ·1 g. (0·03 mol.) of aniline in 8 ml. of con-entrated hydrochloric acid. The temperature f the solution was kept at 0–5° C. during addi-ion. After ten minutes the solution was made lkaline to congo red by the addition of sodium cetate solution. The diazonium solution was dded drop by drop with stirring to a cold olution of 9·1 g. (0·03 mol.) of phthalmido cetoacetic ester, 8·2 g. (0·1 mol.) of sodium cetate, 50 ml. of water and 250 ml. of acetone. 'he temperature was maintained below 10° uring the addition. The mixture was stirred or a further thirty minutes at room tempera-ure, then 100 ml. of water was added before he yellow solid was filtered. The yield of he solid obtained was found to be 8·0 g. 66%) and the melting point 140° C. The solid lay be recrystallized by ethyl acetate.

Melting points and analytical data of the hydrazones prepared are listed in Table. I.

The authors are thankful to Professor R. A. Srivastava for providing the necessary facilities.

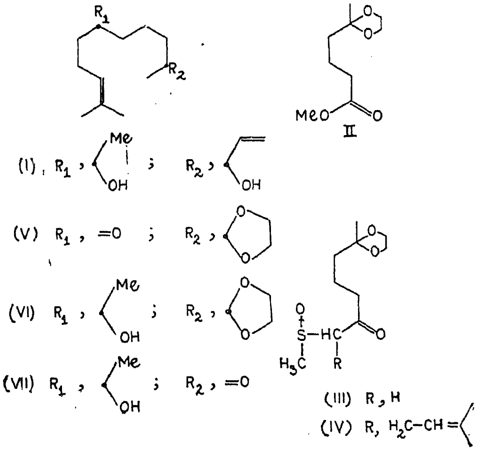
Chemical Laboratories, R. K. SAKSENA.
D.A.V. College, S. D. VERMA.
Kanpur, *December* 4, 1969.

---

1. Wiley and Jarboe, *J. Am. Chem. Soc.*, 1955, **77**, 403.
2. Bulow and Neber, *Ber.*, 1908, **45**, 3732.
3. Goldberg and Kelly, *J. Chem. Soc.*, 1948, p. 1919.
4. Chattway and Ashworth, *Ibid.*, 1933, p. 475.

A SYNTHESIS OF CAPPARAPIDIOL

As a part of our investigations towards the syntheses of terpenoids through *β*-keto-sulphoxide as the key intermediate, we report in the present communication a synthesis of structure (I) assigned to capparapidiol, a sesquiterpene diol isolated[1] from 'capparap' oil.



Methyl 5, 5-ethylenedioxy-hexanoate (II) was prepared by ketalising[2] methyl 5-oxo-

TABLE I
Quantitative separation of Cd^{2+}, Ca^{2+} and $PO_4{}^{3-}$

Trial No.	Cadmium			Calcium			Phosphorus		
	Wt. (mg.)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo	Exptl.	
I	49·900	49·780	0·24	48·096	48·096	0·00	46·530	46·240	0·60
II	62·375	62·225	0·24	60·120	60·006	0·20	55·836	55·836	0·00

TABLE II
Quantitative separation of Pb^{2+}, Ca^{2+} and $PO_4{}^{3-}$

Trial No.	Lead			Calcium			Phosphorus		
	Wt. (mg)		% Error	Wt. (mg.)		% Error	Wt. (mg.)		% Error
	Theo.	Exptl.		Theo.	Exptl.		Theo.	Exptl.	
I	62·150	61·750	0·66	48·096	48·096	0·00	24·816	24·816	0·00
II	82·876	82·470	0·50	60·120	60·000	0·20	31·020	31·020	0·00

liquor for $\sim$ 5 min. filtered through a 1G4 crucible, washed repeatedly with $\sim$ 0·05 M solution of sodium sulphide, the washings being added to the filtrate. Cadmium sulphide was dissolved in minimum volume of $\sim$ 5·0 M hydrochloric acid (nitric acid in the case of lead sulphide), which was heated to boiling. The solutions were made up to known convenient volumes. 10 ml. of the cadmium solution were titrated against standard 0·01 M EDTA at a pH $\sim$ 10 using Eriochrome Black T as indicator till a sharp colour change from wine-red to blue occurred. 10 ml. of lead solution were treated with an excess of standard 0·01 M EDTA, the excess being back-titrated at a pH $\sim$ 10 against standard 0·01 M magnesium sulphate solution using Eriochrome Black T as indicator till there was a sharp colour change from blue to wine-red. The presence of the excess of EDTA in the solution to be titrated can be confirmed by the formation of the blue colour on the addition of the indicator.

The filtrate was boiled to drive off hydrogen sulphide, its calcium and phosphate contents being determined complexometrically as described earlier.[3]

Representative sets of the results are given in Tables I and II. The method suggested was found to be rapid and accurate. It can be extended to the quantitative separation of calcium and phosphate from any metal which forms an insoluble sulphide in the acidic medium, appropriate conditions being adopted for the dissolution of the sulphide for the subsequent complexometric determination.

The authors are thankful to Prof. G. B. Singh, Head of the Chemistry Department, Banaras Hindu University, for providing facilities. Financial assistance given to one of us (RPS) by CSIR (India) is gratefully acknowledged.

Chemistry Department, T. S. B. NARASARAJU.
Banaras Hindu Univ., R. P. SINGH.
Banaras (India), *December* 16, 1969.

1. Salaria, G. B. S., *Anal Chem. Acta*, 1958, **19**, 244.
2. Washburn, M. L. and Shear, M. J., *J. Biol. Chem.*, 1932, **99**, 12; cf. *Z. Anal. Chem.*, 1934, **98**, 53.
3. Singh, R. P., Chickerur, N. S. and Narasaraju, T. S. B., *Ibid.*, 1968, **237**, 117.

SYNTHESIS OF SOME HYDRAZONES

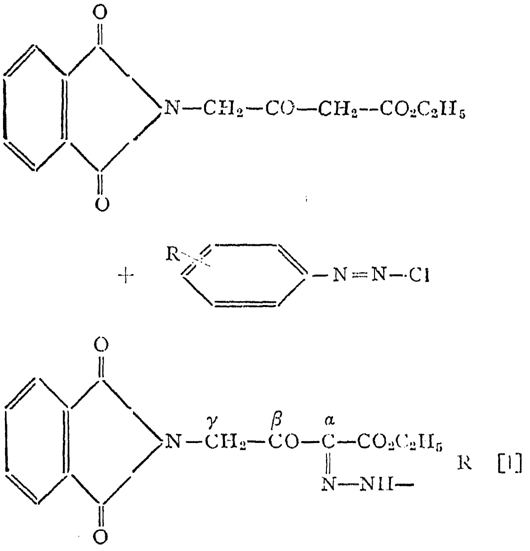
WE wish to report the synthesis of some hydrazones which have been prepared by the coupling of diazonium salt of arylamine with phthalmido acetoacetic ester. Coupling took place at the reactive methylene group, thus giving rise to the desired hydrazone. These compounds could exist either in the azo or in the hydrazone form. Wiley and Jarboe[1] have established by IR and UV data that the hydrazone form is more stable. It has also been confirmed by the coupling of acetoacetic ester with amines that the products obtained were the α-hydrazones,[2–4] and not the azo compounds.

The following route to the formation of ethyl-γ-phthalmido-α-β-dioxobutrate-α-phenyl hydrazone (I) was adopted. A solution of 2·3 g. (0·03 mol.) of sodium nitrite in 8 ml. of water was added slowly below the

TABLE I

Amines	Products formed (mol. formula)	M.P.*	Colour	Yield (%)	Elemental analyses (%)					
					Carbon		Hydrogen		Nitrogen	
					F	C	F	C	F	C
Aniline	$C_{21}H_{19}O_5N_3$	140°	Yellow	66	63·2	63·3	4·5	4·4	11·0	11·1
o-Nitroaniline	$C_{20}H_{16}O_7N_3$	205°	Yellow	65	56·5	56·6	3·6	3·7	13·1	13·2
m-Nitroaniline	$C_{20}H_{16}O_7N_3$	208°	Pale yellow	80	56·4	56·6	3·4	3·7	13·0	13·2
p-Nitroaniline	$C_{20}H_{16}O_7N_3$	220°	Yellow	70	56·5	56·6	3·5	3·7	13·0	12·2
p-Toludine	$C_{21}H_{19}O_5N_3$	140°	Red	40	63·9	64·1	4·8	4·8	10·8	10·7
p-Amino benzene-sulfonamide	$C_{21}H_{20}O_7N_4S$	125°	Light green	60	53·1	53·3	4·2	4·2	11·9	11·8

* All melting points are uncorrected. F = Found ; C = Calculated.



[R=H, -NO_2 (*o*-, -*m*, and -*p*), -CH_3, -SO_2NH_2]

surface of a cold, well-stirred solution of 3·1 g. (0·03 mol.) of aniline in 8 ml. of concentrated hydrochloric acid. The temperature of the solution was kept at 0–5° C. during addition. After ten minutes the solution was made alkaline to congo red by the addition of sodium acetate solution. The diazonium solution was added drop by drop with stirring to a cold solution of 9·1 g. (0·03 mol.) of phthalmido acetoacetic ester, 8·2 g. (0·1 mol.) of sodium acetate, 50 ml. of water and 250 ml. of acetone. The temperature was maintained below 10° during the addition. The mixture was stirred for a further thirty minutes at room temperature, then 100 ml. of water was added before the yellow solid was filtered. The yield of the solid obtained was found to be 8·0 g. (66%) and the melting point 140° C. The solid may be recrystallized by ethyl acetate.

Melting points and analytical data of the hydrazones prepared are listed in Table. I.

The authors are thankful to Professor R. A. Srivastava for providing the necessary facilities.

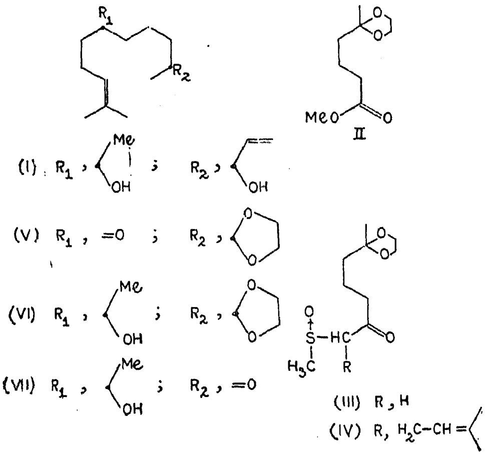
Chemical Laboratories, R. K. SAKSENA.
D.A.V. College, S. D. VERMA.
Kanpur, *December* 4, 1969.

---

1. Wiley and Jarboe, *J. Am. Chem. Soc.*, 1955, **77**, 403.
2. Bulow and Neber, *Ber.*, 1908, **45**, 3732.
3. Goldberg and Kelly, *J. Chem. Soc.*, 1948, p. 1919.
4. Chattway and Ashworth, *Ibid.*, 1923, p. 475.

A SYNTHESIS OF CAPPARAPIDIOL

As a part of our investigations towards the syntheses of terpenoids through β-keto-sulphoxide as the key intermediate, we report in the present communication a synthesis of structure (I) assigned to capparapidiol, a sesquiterpene diol isolated[1] from 'capparap' oil.



Methyl 5, 5-ethylenedioxy-hexanoate (II) was prepared by ketalising[2] methyl 5-oxohexanoate[3] with ethylene glycol in 50% yield (b.p. 105–107°/7–8 mm.). Reaction of (II) with methylsulphinyl carbanion[4] afforded β-ketosulphoxide (III) as a thick oil (b.p. 145–155°/0·5–1 mm. $\nu_{max.}$, 1705, 1040 cm.$^{-1}$). Alkylation[5] of (III) with isoprene bromide in DMF and NaH followed by reductive cleavage[6] of sulphoxide group with Al (amalgam) in 10% aq. THF furnished ketal-ketone (IV) in 40% yield (b.p. 166–168°/10–13 mm. $\nu_{max.}$, 1715, 1060, 1040 cm.$^{-1}$). Grignard reaction on (V) with methylmagnesium iodide secured the corresponding ketal alcohol (VI) in 63% yield (b.p. 150–152°/5–6 mm. $\nu_{max.}$, 3425, 1110, 1060–1040 cm.$^{-1}$). Deketalisation[7] of ketal alcohol with aqueous acetone and PTS furnished keto alcohol (VII) ($\nu_{max.}$ 3425, 1705, 1100 cm.$^{-1}$). Finally, compound (VII) was submitted to the excess of vinyl magnesium bromide in THF to give the diol (1) which showed comparable I.R. spectrum with that reported for capparapidiol.[1]

Wherever necessary the intermediates were chromatographed, fractionated under vacuum and then characterised by analytical and infrared spectral data. A full account of the paper will be published elsewhere when more compounds along these lines would be synthesised.

One of the authors (R. C. A.) is thankful to CSIR for the award of a Junior Research Fellowship.

Department of Chemistry, O. P. Vig.
Panjab University, R. C. Anand.
Chandigarh-14, K. L. Matta.
December 19, 1969.

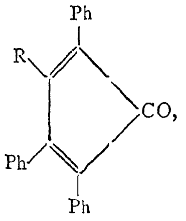
---

1. Castillo, J. B., Brooks, C. J. W. and Campbell, M. M., *Tetrahedron Letters*, 1966, p. 3731.
2. Salmi, *Ber.*, 1938, **71 B**, 1803.
3. Chong, R. and Clezy, P. S., *Austr. J. Chem.*, 1967, **20**, 123.
4. Corey, E. J. and Chaykovsky, M., *J. Am. Chem. Soc.*, 1965, **87**, 1345.
5. Gassman, P. G. and Richmond, G. D., *J. Org. Chem.*, 1966, **31**, 2355.
6. Corey, E. J. and Chaykovsky, M., *J. Am. Chem. Soc.*, 1964, **86**, 1641 ; 1966, **88**, 5498.
7. Johnson, W. S., Bass, J. D. and Williamson, K. L., *Tetrahedron*, 1963, **19**, 862.

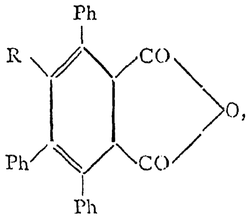
SYNTHESIS OF HYDRINDENE DERIVATIVES

Phenyl acetyl chloride was condensed with Hydrindene in presence of anhydrous aluminium chloride in nitrobenzene to form 5-hydrindyl benzyl ketone, m.p. 111°, yield 47%. The ketone on oxidation with SeO_2 gave the corresponding α-diketone, m.p. 101°, yield 60%, which on treatment with alkaline H_2O_2 gave hydrindene-5-carboxylic acid.

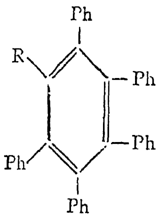
The diketone smoothly condensed with dibenzyl ketone in alcoholic KOH to form the cyclopentadienone derivative (I), m.p. 231°, yield 94%. The compound (I) is a very reactive diene and undergoes normal Diels-Alder reaction with (*a*) maleic anhydride to form (II), m.p. 217°, yield 60%, (*b*) with diphenyl acetylene to form (III), m.p. 305°, yield 80%, (*c*) with benzyne to form (IV), m.p. 175°, yield 70%, and (*d*) with acenaphthylene at high temperature to form (V), m.p. 148°, yield 60%.



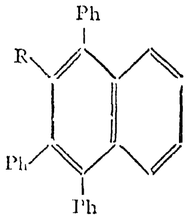
I



II

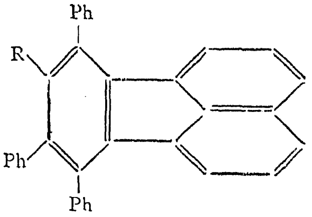


III ,



IV

and



V

where R = 5-Hydrindyl.

Microanalyses were done in Alfred Bernhardt's laboratory, W. Germany. Melting points are not corrected.

Organic Chem. Lab., A. J. Bhattacharjee.
University of Burdwan, S. N. Mandal.
West Bengal (India), *December* 26, 1969.

ON *dl*-SYLVESTRENE

WITH a view to clarifying the contradictions with respect to Baeyer's carvestrene which is arbitrarily considered as *m*-mentha-1(2), 8 (9)-diene* and also assumed to be *dl*-sylvestrene,[3,4] we examined the *m*-menthadienes generated from carvestrene dihydrochloride by reaction with aniline. On subjecting the hydrocarbon mixture to precise fractionation, a cut: b.p. 74–85°/20 mm., n_D^{20} 1·4774, d_{30}^{30} 0·8314 and yielding a tetrabromide, $C_{10}H_{16}Br_4$, m.p. 123·5°, $(\alpha)_D^{30} \pm 0°$ ($CHCl_3$, *c* 2), was obtained. Debromination of the tetrabromide with zinc dust in alcohol-ether medium,[5] afforded a pure (glc) hydrocarbon which conformed to the formula $C_{10}H_{16}$, b.p. 170–171°/736 mm., n_D^{20} 1·4734, $(\alpha)_D^{30} \pm 0°$ ($CHCl_3$, *c* 2) and refused to exhibit any colouration in Wallach's test.[6] N.m.r. spectroscopy revealed that the above hydrocarbon and tetrabromide were respectively *m*-mentha-1(6), 8(9)-diene and 1, 6, 8, 9-tetrabromo-*m*-menthane; moreover, their i.r. and n.m.r. spectra were almost superimposable on the corresponding spectra of *d*-sylvestrene and its tetrabromide.[7] Thus, the identity of the hydrocarbon is firmly established as *dl*-sylvestrene. Carvestrene, if it were *dl*-sylvestrene, must be *dl*-*m*-mentha-1(6), 8(9)-diene. Despite the synthesis of *dl*-*m*-mentha-1(2), 8 (9)-diene,[8] the structure of Baeyer's carvestrene is an open question.

Support to one of us (N. V. M.) from a CSIR (New Delhi) Junior Research Fellowship is gratefully acknowledged.

Dept. of Chemistry, N. V. MURALEEDHARAN.
Christian Medical J. VERGHESE.
College,
Vellore, *December* 30, 1969.

---

* This structure is now attributed to isosylvestrene.[1,2]

1. Bardyshev, I. I. and Balashov, N. M., *Doklady Akad. Nauk BSSR*, 1967, **11** (2), 133.
2. Gollnick, K. K. and Schade, G., *Tetrahedron Letters*, 1966, p. 5157; *Annalen*, 1969, **721**, 133.
3. Baeyer, A., *Chem. Ber.*, 1894, **27**, 3485.
4. Simonsen, J. L. and Owen, L. N., *The Terpenes*, 2nd Edn., Cambridge University Press, 1953, pp. 214, 216.
5. Johny, K. P. and Verghese, J., *Perfumery Essent. Oil Record*, 1968, **59**, 875.
6. Wallach, O., *Annalen*, 1887, **239**, 24.
7. Mathew, C. P. and Verghese, J., *Indian J. Chem.*, 1964 *a*, **2**, 457; *Ibid.*, 1963 *b*, **1**, 229.
8. Vig, O. P., Salota, J. P., Sharma, M. P. and Sharma, S. D., *Ibid.*, 1968, **6**, 188.

CHANGES IN ADENOSINE TRIPHOSPHATE CONTENT IN LIVER IN RATS FOLLOWING PHENYLHYDRAZINE AND 'GCAh' ADMINISTRATION

THE effect of phenylhydrazine and its related compounds such as phenylhydrazone and acetyl phenylhydrazine on the enzymic oxidation of succinate and ubiquinone levels in liver mitochondria has been earlier reported.[1,2] In a previous communication, Nath and associates[3] have shown the effect of phenylhydrazine *in vitro* toward the enhancement of mitochondrial ATPase activity. In a recent article,[4] the authors have reported that the administration of phenylhydrazine results in a pronounced variation of the P/O ratio in rat-liver mitochondria with a concomitant rise in adenosine triphosphatase.

Earlier investigations[5] in this laboratory have indicated that the hydrolysate of the condensation product of glucose and acetoacetate (GCAh), a biological reducing compound,[6] plays some role in the regeneration of hepatic cells damaged by phenylhydrazine. Further, it has been demonstrated that the hydrolyzed product of glucose cycloacetoacetate exhibits a diminishing effect on the phenylhydrazine-enhanced ATPase, and also restores, in part, the mitochondrial efficiency to carry on oxidative phosphorylation.[4] In view of these findings it was considered of interest to investigate the effect of administration of phenylhydrazine and GCAh on adenosine triphosphate content in the liver of rats.

Albino rats (180–200 g.), maintained on a stock laboratory diet and drinking water provided *ad libitum*, were divided into four groups as follows: (I) normal control rats, (II) GCAh-administered rats (80 mg./kg.), (III) phenylhydrazine-administered rats (80 mg./kg.), and (IV) phenylhydrazine-administered rats treated with GCAh. Prior to injecting phenylhydrazine to the animals of IV group, GCAh was subcutaneously administered for two consecutive days and continued thereafter. On the 8th day after phenylhydrazine administration the animals were sacrificed by decapitation and the livers were excised and weighed. Liver adenosine triphosphate was assayed by the hexokinase method.[7] The solution phenylhydrazine was prepared according to the procedure of Chanutin *et al.*[8] The preparation of GCAh has been described before.[4]

Experimental data for ATP content in the liver of rats administered with phenylhydrazine and GCAh are presented in Table I. The results in the table show that there is a marked depletion of adenosine triphosphate in the liver of rats administered with phenylhydrazine. The data further reveal that the values obtained with the liver of phenylhydrazine-administered rats treated with glucose cycloacetoacetate hydrolyzate is near about to normal controls. GCAh, however, is ineffective on the ATP content of normal rat-liver.

TABLE I

Hepatic adenosine triphosphate in phenylhydrazine and GCAh injected rats

	Condition	No. of animals	Total liver weight (g.)	ATP (mμ moles/g. liver)	Percentage difference (mμ moles/g. liver)
I	Normal ..	4	3·697 (±0·058)	1473 (± 67)	..
II	GCAh ..	4	3·704 (±0·063)	1479 (± 59)	< 1
III	Phenylhydrazine	4	3·679 (±0·065)	634 (± 44)	57
IV	Phenylhydrazine *plus* GCAh	4	3·693 (±0·052)	1149 (± 62)	22

GCAh, glucose cycloacetoacetate hydrolyzate. Values refer to the means, with standard deviations included in parentheses.

Our previous study[4] of the effect of phenylhydrazine on rat-liver mitochondria suggests a decrease of the P/O ratios, sluggish respiration and an increase in ATPase activity. In all likelihood, the diminution in liver ATP levels in phenylhydrazine-administered rats might have been due to differences in oxidative phosphorylation in the liver mitochondria as noted in our earlier investigations. The effect of GCAh on adenosine triphosphate in the liver of phenylhydrazine-administered rats may be explained as due to its as yet unknown influence against phenylhydrazine on the mitochondrial oxidative phosphorylation efficiency.

The authors are thankful to the Council of Scientific and Industrial Research, New Delhi, for a grant.

Dept. of Biochemistry, T. G. REDDI.
University of Nagpur, M. C. NATH.
Nagpur, *January* 1, 1970.

---

1. Ozawa, H. and Asami, K., *Seikagaku*, 1963, **35**, 798.
2. Asami, K. and Ozawa, H., *Ibid.*, 1964, **36**, 730.
3. Nath, M. C., Reddi, T. G. and Nath, N., *Nature*, 1968, **217**, 552.
4. Reddi, T. G. and Nath, M. C., *Can. J. Biochem.*, 1969, **47**, 297.
5. Nath, M. C. and Prasannan, K. G., *Biochem. J.*, 1959, **73**, 729.
6. — and Sahu, V, K., *J. Sci. & Ind. Res.*, 1953, **12 B**, 191.
7. Strehler, B. L. and Totter, J. R., *Methods in Biochemical Analysis*, Interscience Publishers, Inc., New York, **1954**, **1**, 341.
8. Chanutin, A., Lentz, E. A. and Ludewig, S., *Am. J. Physiol.*, 1953, **173**, 474.

RELATION BETWEEN FRACTURE TRACES AND DRAINAGE LINES

FRACTURE traces have been defined as the small-scale linear features that have less than one mile of continuous expression as viewed on aerial photographs. Nearly all workers[1,2] in this field have considered the fracture traces as the surface expression of joints or zones of joint concentration. The study here is to find out if any relation exists between fracture traces and the first-order drainage lines. The area under study lies between latitudes 21° 50′ and 22° 0′ N. and longitudes 85° 27′ and 85° 30′ E. in Sheet No. 73 G/5, in the Keonjhar District, Orissa. Basal sandstone horizon of the Iron Ore Series of the Precambrian formations covers the whole area. Fracture traces seem to be entirely confined to the Sandstone horizon only, while large-scale fracture patterns and lineaments are observed in the neighbouring areas. Physiographically this forms part of a dissected erosion surface (2,200 to 2,000 feet above M.S.L.) and the hilly tracts are fully covered with thick vegetation.

Aerial photographs on a scale two inches to a mile of the Iron Ore Region of Bihar and Orissa are being studied for the geomorphology of the region and the orientations of the fracture traces in this limited area have been obtained during this study. Necessary precautions have been taken to reduce the errors caused by radial distortion and relief displacement while taking the data from aerial photographs. The directions of fracture traces are measured and their frequency is obtained in each range of 10 degrees from due north. The directions of each of the first-order drainage lines, taken from toposheet and modified by a study on aerial photographs, where necessary, are measured and the frequen-

ces in each of the [illegible] were obtained. The data are tabulated in Table I. From the

TABLE I

S. No.	Range of direction in degree from N.	Frequency of fracture traces	Frequency of first-order drainage lines
1	01–10	31	11
2	11–20	44	11
3	21–30	30	13
4	31–40	24	11
5	41–50	28	11
6	51–60	13	11
7	61–70	20	15
8	71–80	[illegible]	7
9	81–90	10	7
10	91–100	16	8
11	101–110	15	7
12	111–120	14	8
13	121–130	9	6
14	131–140	9	9
15	141–150	21	10
16	151–160	25	17
17	161–170	25	12
18	171–180	17	12
		360	186

data presented in the table, a chi-square test is performed to see whether the population corresponding to both the phenomena are the same. The calculated value of the statistic [illegible] is [illegible] than the table value at [illegible] level of significance, i.e., [illegible]. We [illegible] that [illegible] phenomena follow [illegible] that the proportions of the frequencies of fracture traces and drainage lines in any given range is the same. [illegible] that there is a clear relation between the two phenomena. It may be [illegible] that the present drainage lines are controlled by the fracture traces.

Trainer and Ellison[3] suggest that structure and lithology control the formation of fracture traces. Lithology is considered to have an effective control over the abundance and length of fracture traces than on their trends. Lattman[4] comparing the results obtained from the field observations and those from the photographs suggests that there is a significant parallelism between the fracture traces and the bed rock joints. Judson and Andrews[5] from a study of a [illegible] have [illegible] that there is a marked coincidence in the trends of the stream valleys, including those small ones containing the first-order drainage lines of the slopes of hill ranges, and the joint pattern. Hence, it is very likely that the stream valleys here, which are only results of erosion by the drainage in these directions, are essentially controlled by joints in the area as well.

The importance of the study is to indicate how one can arrive at the trends of certain structural elements even when the area is thickly covered with vegetation and is inaccessible.

Thanks are due to the Ministry of Defence for permission to study the aerial photographs in the Survey of India Office, and to Dr. Y. R. Sarma for kindly suggesting the method of statistical analysis of the data obtained. The financial assistance of the Council of Scientific and Industrial Research to one of the authors (K. L. V. R.) is thankfully acknowledged.

Geology Department, K. L. V. Ramana Rao
Andhra University, R. Vaidyanadhan.
Waltair, *December* 19, 1969

1. Blanchet, P. H., *Bull. Am. Ass. Petrol. Geol.*, 1957, **41**, 1748.
2. Wobber, F. J., *Photogramm. Engng.*, 1967, **33**, 499.
3. Trainer, F. W. and Ellison, R. L., *Ibid.*, 1967, **33**, 190.
4. Lattman, L. H., *Ibid.*, 1958, **24**, 568.
5. Judson, S. and Andrews, G. W., *Jour. Geol.*, 1955, **63**, 328.

TWIN INVESTIGATION IN LEPROSY IN WEST BENGAL

There is some evidence that genetic factors might influence susceptibility and course of leprosy. The blood groups seem to have some influence[1] and besides, family data seem to point to some family correlation of the type of leprosy. However, due to the high correlation of genetic and environmental factors, family investigation will not allow any definite conclusion as to the possible influence of heredity as a family correlation could also be explained by higher risk of infection.

Here, the twin method offers unique possibilities for research. Monozygotic and Dizygotic twins are generally living under the same conditions in their families. If Mz twins who are identical genetically, would show higher concordance in incidence and type of leprosy than Dz twins, this would be a strong argument in favour of genetical factors. If, on the other hand, not all Mz twins could be concordant as to leprosy, an analysis of discordant Mz twins would offer a unique chance of analysing the environmental conditions which influence differences in Mz twins. The well known twin investigations on Tuberculosis[2] could serve as a guide for possible points of view.

A research programme was thus undertaken jointly by the Indian Statistical Institute,

Experimental data for ATP content in the liver of rats administered with phenylhydrazine and GCAh are presented in Table I. The results in the table show that there is a marked depletion of adenosine triphosphate in the liver of rats administered with phenylhydrazine. The data further reveal that the values obtained with the liver of phenylhydrazine-administered rats treated with glucose cycloacetoacetate hydrolyzate is near about to normal controls. GCAh, however, is ineffective on the ATP content of normal rat-liver.

TABLE I

Hepatic adenosine triphosphate in phenylhydrazine and GCAh injected rats

Condition		No. of animals	Total liver weight (g.)	ATP (mμ moles/g. liver)	Percentage difference (mμ moles/g. liver)
I	Normal ..	4	3·697 (±0·058)	1473 (± 67)	..
II	GCAh ..	4	3·704 (±0·063)	1479 (± 59)	< 1
III	Phenylhydrazine	4	3·679 (±0·065)	634 (± 44)	57
IV	Phenylhydrazine *plus* GCAh	4	3·693 (±0·052)	1149 (± 62)	22

GCAh, glucose cycloacetoacetate hydrolyzate. Values refer to the means, with standard deviations included in parentheses.

Our previous study[4] of the effect of phenylhydrazine on rat-liver mitochondria suggests a decrease of the P/O ratios, sluggish respiration and an increase in ATPase activity. In all likelihood, the diminution in liver ATP levels in phenylhydrazine-administered rats might have been due to differences in oxidative phosphorylation in the liver mitochondria as noted in our earlier investigations. The effect of GCAh on adenosine triphosphate in the liver of phenylhydrazine-administered rats may be explained as due to its as yet unknown influence against phenylhydrazine on the mitochondrial oxidative phosphorylation efficiency.

The authors are thankful to the Council of Scientific and Industrial Research, New Delhi, for a grant.

Dept. of Biochemistry, T. G. REDDI.
University of Nagpur, M. C. NATH.
Nagpur, *January* 1, 1970.

---

1. Ozawa, H. and Asami, K., *Seikagaku*, 1963, **35**, 798.
2. Asami, K. and Ozawa, H., *Ibid.*, 1964, **36**, 730.
3. Nath, M. C., Reddi, T. G. and Nath, N., *Nature*, 1968, **217**, 552.
4. Reddi, T. G. and Nath, M. C., *Can. J. Biochem.*, 1969, **47**, 297.
5. Nath, M. C. and Prasannan, K. G., *Biochem. J.*, 1959, **73**, 729.
6. — and Sahu, V, K., *J. Sci. & Ind. Res.*, 1953, **12 B**, 191.
7. Strehler, B. L. and Totter, J. R., *Methods in Biochemical Analysis*, Interscience Publishers, Inc., New York, 1954, **1**, 341.
8. Chanutin, A., Lentz, E. A. and Ludewig, S., *Am. J. Physiol.*, 1953, **173**, 474.

RELATION BETWEEN FRACTURE TRACES AND DRAINAGE LINES

FRACTURE traces have been defined as the small-scale linear features that have less than one mile of continuous expression as viewed on aerial photographs. Nearly all workers[1,2] in this field have considered the fracture traces as the surface expression of joints or zones of joint concentration. The study here is to find out if any relation exists between fracture traces and the first-order drainage lines. The area under study lies between latitudes 21° 50′ and 22° 0′ N. and longitudes 85° 27′ and 85° 30′ E. in Sheet No. 73 G/5, in the Keonjhar District, Orissa. Basal sandstone horizon of the Iron Ore Series of the Precambrian formations covers the whole area. Fracture traces seem to be entirely confined to the Sandstone horizon only, while large-scale fracture patterns and lineaments are observed in the neighbouring areas. Physiographically this forms part of a dissected erosion surface (2,200 to 2,000 feet above M.S.L.) and the hilly tracts are fully covered with thick vegetation.

Aerial photographs on a scale two inches to a mile of the Iron Ore Region of Bihar and Orissa are being studied for the geomorphology of the region and the orientations of the fracture traces in this limited area have been obtained during this study. Necessary precautions have been taken to reduce the errors caused by radial distortion and relief displacement while taking the data from aerial photographs. The directions of fracture traces are measured and their frequency is obtained in each range of 10 degrees from due north. The directions of each of the first-order drainage lines, taken from toposheet and modified by a study on aerial photographs, where necessary, are measured and the frequen-

cies in each of the same range are obtained. The data are tabulated in Table I. From the data presented in the table, a chi-square test is performed to see whether the population corresponding to both the phenomena are the same. The calculated value of the statistic χ^2 is 16.7, it is less than the table value at 5% level of significance under 17 d.f. We may therefore conclude that both the phenomena follow the same distribution and that the probability of the frequency of fracture traces and drainage lines in any given range is the same. This indicates that there is a clear relation between the two phenomena. It may be said that the present drainage lines are controlled by the fracture traces.

TABLE I

S. No.	Range of direction in degrees from N.	Frequency of fracture traces	Frequency of first order drainage lines
1	01–10	31	11
2	11–20	49	11
3	21–30	30	13
4	31–40	23	11
5	41–50	28	11
6	51–60	13	11
7	61–70	20	15
8	71–80	7	7
9	81–90	10	7
10	91–100	16	8
11	101–110	15	7
12	111–120	14	8
13	121–130	9	6
14	131–140	9	9
15	141–150	21	10
16	151–160	28	17
17	161–170	25	12
18	171–180	17	12
		365	186

Trainer and Ellison[3] suggest that structure and lithology control the formation of fracture traces. Lithology is considered to have an effective control more on the abundance and length of fracture traces than on their trends. Lattman[4] comparing the results obtained from the field observations and those from the photographs suggests that there is a significant parallelism between the fracture traces and the bedrock joints. Judson and Andrews[5] from a study of a similar area have shown that there is a marked coincidence in the strike of the stream valleys, including those small ones containing the first order drainage lines of the slopes of hill ranges, and the joint pattern. Hence, it is very likely that the stream valleys here, which are only results of erosion by the drainage in those directions, are essentially controlled by joints in this area as well.

The importance of this study is to indicate how one can arrive at the trends of certain structural elements even when the area is thickly covered with vegetation and is inaccessible.

Thanks are due to the Ministry of Defence for permission to study the aerial photographs in the Survey of India Offices and to Dr. Y. R. Sarma for kindly suggesting the method of statistical analysis of the data obtained. The financial assistance of the Council of Scientific and Industrial Research to one of the authors (K. L. V. R.) is thankfully acknowledged.

Geology Department, K. L. V. Ramana Rao.
Andhra University, R. Vaidyanadhan.
Waltair, *December* 19, 1969.

1. Blanchet, P. H., *Bull. Am. Ass. Petro. Geol.*, 1957, **41**, 1748.
2. Wobber, F. J., *Photogr. Eng.*, 1967, **33**, 499.
3. Trainer, F. W. and Ellison, R. L., *Ibid.*, 1967, **33**, 190.
4. Lattman, L. H., *Ibid.*, 1958, **24**, 568.
5. Judson, S. and Andrews, G. W., *Jour. Geol.*, 1955, **63**, 328.

TWIN INVESTIGATION IN LEPROSY IN WEST BENGAL

There is some evidence that genetic factors might influence susceptibility and course of leprosy. The blood groups seem to have some influence[1] and besides, family data seem to point to some family correlation of the type of leprosy. However, due to the high correlation of genetic and environmental factors, family investigation will not allow any definite conclusion as to the possible influence of heredity as a family correlation could also be explained by higher risk of infection.

Here, the twin method offers unique possibilities for research. Monozygotic and Dizygotic twins are generally living under the same condition in their families. If Mz twins who are identical genetically, would show higher concordance in incidence and type of leprosy than Dz twins, this would be a strong argument in favour of genetical factors. If, on the other hand, not all Mz twins could be concordant as to leprosy, an analysis of discordant Mz twins would offer a unique chance of analysing the environmental conditions which influence differences in Mz twins. The well-known twin investigations on Tuberculosis[2] could serve as a guide for possible points of view.

A research programme was thus undertaken jointly by the Indian Statistical Institute,

Experimental data for ATP content in the liver of rats administered with phenylhydrazine and GCAh are presented in Table I. The results in the table show that there is a marked depletion of adenosine triphosphate in the liver of rats administered with phenylhydrazine. The data further reveal that the values obtained with the liver of phenylhydrazine-administered rats treated with glucose cycloacetoacetate hydrolyzate is near about to normal controls. GCAh, however, is ineffective on the ATP content of normal rat-liver.

TABLE I

Hepatic adenosine triphosphate in phenylhydrazine and GCAh injected rats

	Condition		No. of animals	Total liver weight (g.)	ATP(mμ moles/g. liver)	Percentage difference (mμ moles/g. liver)
I	Normal	..	4	3·697 (±0·058)	1473 (± 67)	..
II	GCAh	..	4	3·704 (±0·063)	1479 (± 59)	< 1
III	Phenylhydrazine		4	3·679 (±0·065)	634 (± 44)	57
IV	Phenylhydrazine *plus* GCAh		4	3·693 (±0·052)	1149 (± 62)	22

GCAh, glucose cycloacetoacetate hydrolyzate. Values refer to the means, with standard deviations included in parentheses.

Our previous study[4] of the effect of phenylhydrazine on rat-liver mitochondria suggests a decrease of the P/O ratios, sluggish respiration and an increase in ATPase activity. In all likelihood, the diminution in liver ATP levels in phenylhydrazine-administered rats might have been due to differences in oxidative phosphorylation in the liver mitochondria as noted in our earlier investigations. The effect of GCAh on adenosine triphosphate in the liver of phenylhydrazine-administered rats may be explained as due to its as yet unknown influence against phenylhydrazine on the mitochondrial oxidative phosphorylation efficiency.

The authors are thankful to the Council of Scientific and Industrial Research, New Delhi, for a grant.

Dept. of Biochemistry,
University of Nagpur,
Nagpur, *January* 1, 1970.

T. G. REDDI.
M. C. NATH.

---

1. Ozawa, H. and Asami, K., *Seikagaku*, 1963, **35**, 798.
2. Asami, K. and Ozawa, H., *Ibid.*, 1964, **36**, 730.
3. Nath, M. C., Reddi, T. G. and Nath, N., *Nature*, 1968, **217**, 552.
4. Reddi, T. G. and Nath, M. C., *Can. J. Biochem.*, 1969, **47**, 297.
5. Nath, M. C. and Prasannan, K. G., *Biochem. J.*, 1959, **73**, 729.
6. — and Sahu, V, K., *J. Sci. & Ind. Res.*, 1953, **12 B**, 191.
7. Strebler, B. L. and Totter, J. R., *Methods in Biochemical Analysis*, Interscience Publishers, Inc., New York, **1954**, **1**, **341**.
8. Chanutin, A., Lentz, E. A. and Ludewig, S., *Am. J. Physiol.*, 1953, **173**, 474.

RELATION BETWEEN FRACTURE TRACES AND DRAINAGE LINES

FRACTURE traces have been defined as the small-scale linear features that have less than one mile of continuous expression as viewed on aerial photographs. Nearly all workers[1,2] in this field have considered the fracture traces as the surface expression of joints or zones of joint concentration. The study here is to find out if any relation exists between fracture traces and the first-order drainage lines. The area under study lies between latitudes 21° 50′ and 22° 0′ N. and longitudes 85° 27′ and 85° 30′ E. in Sheet No. 73 G/5, in the Keonjhar District, Orissa. Basal sandstone horizon of the Iron Ore Series of the Precambrian formations covers the whole area. Fracture traces seem to be entirely confined to the Sandstone horizon only, while large-scale fracture patterns and lineaments are observed in the neighbouring areas. Physiographically this forms part of a dissected erosion surface (2,200 to 2,000 feet above M.S.L.) and the hilly tracts are fully covered with thick vegetation.

Aerial photographs on a scale two inches to a mile of the Iron Ore Region of Bihar and Orissa are being studied for the geomorphology of the region and the orientations of the fracture traces in this limited area have been obtained during this study. Necessary precautions have been taken to reduce the errors caused by radial distortion and relief displacement while taking the data from aerial photographs. The directions of fracture traces are measured and their frequency is obtained in each range of 10 degrees from due north. The directions of each of the first-order drainage lines, taken from toposheet and modified by a study on aerial photographs, where necessary, are measured and the frequen-

es in each of the same ranges are obtained. he data are tabulated in Table I. From the

TABLE I

S. o.	Range of direction in degree from N.	Frequency of fracture traces	Frequency of first order drainage lines
1	01–10	31	11
2	11–20	49	11
3	21–30	30	13
4	31–40	23	11
5	41–50	28	11
6	51–60	13	11
7	61–70	20	15
8	71–80	7	7
9	81–90	10	7
0	91 100	16	8
1	101 110	15	7
2	111–120	14	8
3	121–130	9	6
4	131–140	9	9
5	141–150	21	10
6	151–160	28	17
7	161–170	25	12
8	171–180	17	12
		365	186

ata presented in the table, a chi-square test performed to see whether the populations orresponding to both the phenomena are the ame. The calculated value of the statistic ^{2} is 16·3745 which is less than the table alue at 1% level of significance under 17 d.f. Ve may thus consider that both the phenomena follow the same distribution and that he probability of the frequencies of fracture races and drainage lines in any given range s the same. This indicates that there is a lear relation between the two phenomena. t may be said that the present drainage lines re controlled by the fracture traces.

Trainer and Ellison[3] suggest that structure nd lithology control the formation of fracture races. Lithology is considered to have an ffective control more on the abundance and ength of fracture traces than on their trends. attman[4] comparing the results obtained rom the field observations and those from the hotographs suggests that there is a significant arallelism between the fracture traces and the ed rock joints. Judson and Andrews[5] from a tudy of a driftless area have shown that there s a marked coincidence in the strike of the tream valleys, including those small ones ontaining the first-order drainage lines of the lopes of hill ranges, and the joint pattern. Hence, it is very likely that the stream valleys ere, which are only results of erosion by the rainage in those directions, are essentially ontrolled by joints in this area as well.

The importance of this study is to indicate how one can arrive at the trends of certain structural elements even when the area is thickly covered with vegetation and is inaccessible.

Thanks are due to the Ministry of Defence for permission to study the aerial photographs in the Survey of India Offices and to Dr. Y. R. Sarma for kindly suggesting the method of statistical analysis of the data obtained. The financial assistance of the Council of Scientific and Industrial Research to one of the authors (K. L. V. R.) is thankfully acknowledged.

Geology Department, K. L. V. RAMANA RAO.
Andhra University, R. VAIDYANADHAN.
Waltair, December 19, 1969.

---

1. Blanchet, P. H., *Bull. Am. Asso. Petro. Geol.*, 1957, **41**, 1748.
2. Wobber, J. F., *Photogr. Engg.*, 1967, **33**, 499.
3. Trainer, F. W. and Ellison, R. L., *Ibid.*, 1967, **33**, 190.
4. Lattman, L. H., *Ibid.*, 1958, **24**, 568.
5. Judson, S. and Andrews, G. W., *Jour. Geol.*, 1955, **63**, 328.

TWIN INVESTIGATION IN LEPROSY IN WEST BENGAL

THERE is some evidence that genetic factors might influence susceptibility and cause of leprosy. The blood groups seem to have some influence[1] and besides, family data seem to point to some family correlation of the type of leprosy. However, due to the high correlation of genetic and environmental factors, family investigation will not allow any definite conclusion as to the possible influence of heredity as a family correlation could also be explained by higher risk of infection.

Here, the twin method offers unique possibilities for research. Monozygotic and Dizygotic twins are generally living under the same conditions in their families. If Mz twins who are identical genetically, would show higher concordance in incidence and type of leprosy than Dz twins, this would be a strong argument in favour of genetical factors. If, on the other hand, not all Mz twins could be concordant as to leprosy, an analysis of discordant Mz twins would offer a unique chance of analysing the environmental conditions which influence differences in Mz twins. The well-known twin investigations on Tuberculosis[2] could serve as a guide for possible points of view.

A research programme was thus undertaken jointly by the Indian Statistical Institute,

Experimental data for ATP content in the liver of rats administered with phenylhydrazine and GCAh are presented in Table I. The results in the table show that there is a marked depletion of adenosine triphosphate in the liver of rats administered with phenylhydrazine. The data further reveal that the values obtained with the liver of phenylhydrazine-administered rats treated with glucose cycloacetoacetate hydrolyzate is near about to normal controls. GCAh, however, is ineffective on the ATP content of normal rat-liver.

TABLE I

Hepatic adenosine triphosphate in phenylhydrazine and GCAh injected rats

	Condition		No. of animals	Total liver weight (g.)	ATP (mμ moles/g. liver)	Percentage difference (mμ moles/g. liver)
I	Normal	..	4	3·697 (±0·058)	1473 (± 67)	..
II	GCAh	..	4	3·704 (±0·063)	1479 (± 59)	< 1
III	Phenylhydrazine		4	3·679 (±0·065)	634 (± 44)	57
IV	Phenylhydrazine *plus* GCAh		4	3·693 (±0·052)	1149 (± 62)	22

GCAh, glucose cycloacetoacetate hydrolyzate. Values refer to the means, with standard deviations included in parentheses.

Our previous study[4] of the effect of phenylhydrazine on rat-liver mitochondria suggests a decrease of the P/O ratios, sluggish respiration and an increase in ATPase activity. In all likelihood, the diminution in liver ATP levels in phenylhydrazine-administered rats might have been due to differences in oxidative phosphorylation in the liver mitochondria as noted in our earlier investigations. The effect of GCAh on adenosine triphosphate in the liver of phenylhydrazine-administered rats may be explained as due to its as yet unknown influence against phenylhydrazine on the mitochondrial oxidative phosphorylation efficiency.

The authors are thankful to the Council of Scientific and Industrial Research, New Delhi, for a grant.

Dept. of Biochemistry,
University of Nagpur,
Nagpur, *January* 1, 1970.

T. G. REDDI.
M. C. NATH.

---

1. Ozawa, H. and Asami, K., *Seikagaku*, 1963, **35**, 798.
2. Asami, K. and Ozawa, H., *Ibid.*, 1964, **36**, 780.
3. Nath, M. C., Reddi, T. G. and Nath, N., *Nature*, 1968, **217**, 552.
4. Reddi, T. G. and Nath, M. C., *Can. J. Biochem.*, 1969, **47**, 297.
5. Nath, M. C. and Prasannan, K. G., *Biochem. J.*, 1959, **73**, 729.
6. — and Sahu, V, K., *J. Sci. & Ind. Res.*, 1953, **12 B**, 191.
7. Strebler, B. L. and Totter, J. R., *Methods in Biochemical Analysis*, Interscience Publishers, Inc., New York, 1954, **1**, 341.
8. Chanutin, A., Lentz, E. A. and Ludewig, S., *Am. J. Physiol.*, 1953, **173**, 474.

RELATION BETWEEN FRACTURE TRACES AND DRAINAGE LINES

FRACTURE traces have been defined as the small-scale linear features that have less than one mile of continuous expression as viewed on aerial photographs. Nearly all workers[1,2] in this field have considered the fracture traces as the surface expression of joints or zones of joint concentration. The study here is to find out if any relation exists between fracture traces and the first-order drainage lines. The area under study lies between latitudes 21° 50′ and 22° 0′ N. and longitudes 85° 27′ and 85° 30′ E. in Sheet No. 73 G/5, in the Keonjhar District, Orissa. Basal sandstone horizon of the Iron Ore Series of the Precambrian formations covers the whole area. Fracture traces seem to be entirely confined to the Sandstone horizon only, while large-scale fracture patterns and lineaments are observed in the neighbouring areas. Physiographically this forms part of a dissected erosion surface (2,200 to 2,000 feet above M.S.L.) and the hilly tracts are fully covered with thick vegetation.

Aerial photographs on a scale two inches to a mile of the Iron Ore Region of Bihar and Orissa are being studied for the geomorphology of the region and the orientations of the fracture traces in this limited area have been obtained during this study. Necessary precautions have been taken to reduce the errors caused by radial distortion and relief displacement while taking the data from aerial photographs. The directions of fracture traces are measured and their frequency is obtained in each range of 10 degrees from due north. The directions of each of the first-order drainage lines, taken from toposheet and modified by a study on aerial photographs, where necessary, are measured and the frequen-

[illegible]

No.	[illegible]	[illegible]	[illegible]
1	[illegible]	[illegible]	11
2	[illegible]	[illegible]	11
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	11
5	[illegible]	[illegible]	13
6	[illegible]	1	11
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	6
14	[illegible]	[illegible]	9
15	[illegible]	[illegible]	10
16	[illegible]	[illegible]	12
17	[illegible]	[illegible]	12
18	[illegible]	[illegible]	12
		[illegible]	[illegible]

data [illegible]

Tracer [illegible]

[illegible] controlled [illegible]

[illegible] of the [illegible] when [illegible] with [illegible]

[illegible] thanks are due to the Ministry of Defence [illegible] aerial photographs [illegible] of India [illegible] Dr. [illegible] of the [illegible] of the Council of [illegible] R. V. R. [illegible] acknowledged.

[illegible] Department, [illegible] R. V. [illegible]
[illegible] University [illegible]
[illegible] 19, 1969.

1. [illegible] F. H., [illegible], 1962, 41, [illegible]
2. W[illegible], 1967, 33, [illegible]
3. [illegible], J. W. and [illegible], J. J., [illegible], 33, [illegible]
4. [illegible], I. H., [illegible], 1968, 24, 568.
5. [illegible] W., [illegible], 13, [illegible]

TWIN INVESTIGATION IN LEPROSY IN WEST BENGAL

[illegible] studies that genetic factors [illegible] family data seem to point to some family correlation of the type of leprosy. However due to the high correlation [illegible] genetic and environmental factors, [illegible] will not allow any definite conclusion as to the possible influence of [illegible] family correlation could also [illegible] higher risk of infection.

Here the twin method offers unique possibilities for research. Monozygotic and Dizygotic twins are generally living under the same conditions in their families. If MZ twins who are genetically identical would show higher concordance in incidence and type of leprosy than DZ twins, this would be a strong argument in favour of genetical factors. If, on the other hand, not all MZ twins could be concordant as to leprosy, an analysis of discordant MZ twins would offer a unique chance of analysing the environmental conditions which influence differences in MZ twins. The well known twin investigations on Tuberculosis could serve as a model for possible points of view.

A research programme was thus undertaken jointly by the Indian Statistical Institute,

Experimental data for ATP content in the liver of rats administered with phenylhydrazine and GCAh are presented in Table I. The results in the table show that there is a marked depletion of adenosine triphosphate in the liver of rats administered with phenylhydrazine. The data further reveal that the values obtained with the liver of phenylhydrazine-administered rats treated with glucose cycloacetoacetate hydrolyzate is near about to normal controls. GCAh, however, is ineffective on the ATP content of normal rat-liver.

TABLE I

Hepatic adenosine triphosphate in phenylhydrazine and GCAh injected rats

	Condition	No. of animals	Total liver weight (g.)	ATP (mμ moles/ g. liver)	Percentage difference (mμ moles/g. liver)
I	Normal ..	4	3·697 (±0·058)	1473 (± 67)	..
II	GCAh ..	4	3·704 (±0·063)	1479 (± 59)	< 1
III	Phenylhydrazine	4	3·679 (±0·065)	634 (± 44)	57
IV	Phenylhydrazine *plus* GCAh	4	3·693 (±0·052)	1149 (± 62)	22

GCAh, glucose cycloacetoacetate hydrolyzate. Values refer to the means, with standard deviations included in parentheses.

Our previous study[4] of the effect of phenylhydrazine on rat-liver mitochondria suggests a decrease of the P/O ratios, sluggish respiration and an increase in ATPase activity. In all likelihood, the diminution in liver ATP levels in phenylhydrazine-administered rats might have been due to differences in oxidative phosphorylation in the liver mitochondria as noted in our earlier investigations. The effect of GCAh on adenosine triphosphate in the liver of phenylhydrazine-administered rats may be explained as due to its as yet unknown influence against phenylhydrazine on the mitochondrial oxidative phosphorylation efficiency.

The authors are thankful to the Council of Scientific and Industrial Research, New Delhi, for a grant.

Dept. of Biochemistry,
University of Nagpur,
Nagpur, *January* 1, 1970.

T. G. REDDI.
M. C. NATH.

---

1. Ozawa, H. and Asami, K., *Seikagaku*, 1963, **35**, 798.
2. Asami, K. and Ozawa, H., *Ibid.*, 1964, **36**, 730.
3. Nath, M. C., Reddi, T. G. and Nath, N., *Nature*, 1968, **217**, 552.
4. Reddi, T. G. and Nath, M. C., *Can. J. Biochem.*, 1969, **47**, 297.
5. Nath, M. C. and Prasannan, K. G., *Biochem. J.*, 1959, **73**, 729.
6. — and Sahu, V. K., *J. Sci. & Ind. Res.*, 1953, **12 B**, 191.
7. Strebler, B. L. and Totter, J. R., *Methods in Biochemical Analysis*, Interscience Publishers, Inc., New York, 1954, **1**, 341.
8. Chanutin, A., Lentz, E. A. and Ludewig, S., *Am. J. Physiol.*, 1953, **173**, 474.

RELATION BETWEEN FRACTURE TRACES AND DRAINAGE LINES

FRACTURE traces have been defined as the small-scale linear features that have less than one mile of continuous expression as viewed on aerial photographs. Nearly all workers[1,2] in this field have considered the fracture traces as the surface expression of joints or zones of joint concentration. The study here is to find out if any relation exists between fracture traces and the first-order drainage lines. The area under study lies between latitudes 21° 50′ and 22° 0′ N. and longitudes 85° 27′ and 85° 30′ E. in Sheet No. 73 G/5, in the Keonjhar District, Orissa. Basal sandstone horizon of the Iron Ore Series of the Precambrian formations covers the whole area. Fracture traces seem to be entirely confined to the Sandstone horizon only, while large-scale fracture patterns and lineaments are observed in the neighbouring areas. Physiographically this forms part of a dissected erosion surface (2,200 to 2,000 feet above M.S.L.) and the hilly tracts are fully covered with thick vegetation.

Aerial photographs on a scale two inches to a mile of the Iron Ore Region of Bihar and Orissa are being studied for the geomorphology of the region and the orientations of the fracture traces in this limited area have been obtained during this study. Necessary precautions have been taken to reduce the errors caused by radial distortion and relief displacement while taking the data from aerial photographs. The directions of fracture traces are measured and their frequency is obtained in each range of 10 degrees from due north. The directions of each of the first-order drainage lines, taken from toposheet and modified by a study on aerial photographs, where necessary, are measured and the frequen-

cies in each of the same ranges are obtained. The data are tabulated in Table I. From the data presented in the table, a chi-square test is performed to see whether the populations corresponding to both the phenomena are the same. The calculated value of the statistic χ^2 is 16·3745 which is less than the table value at 1% level of significance under 17 d.f. We may thus consider that both the phenomena follow the same distribution and that the probability of the frequencies of fracture traces and drainage lines in any given range is the same. This indicates that there is a clear relation between the two phenomena. It may be said that the present drainage lines are controlled by the fracture traces.

TABLE I

S. No.	Range of direction in degree from N.	Frequency of fracture traces	Frequency of first order drainage lines
1	01-10	31	11
2	11-20	49	11
3	21-30	30	13
4	31-40	23	11
5	41-50	28	11
6	51-60	13	11
7	61-70	20	15
8	71-80	7	7
9	81-90	10	7
10	91 100	16	8
11	101 110	15	7
12	111-120	14	8
13	121-130	9	6
14	131-140	9	9
15	141-150	21	10
16	151-160	28	17
17	161-170	25	12
18	171-180	17	12
		365	186

Trainer and Ellison[3] suggest that structure and lithology control the formation of fracture traces. Lithology is considered to have an effective control more on the abundance and length of fracture traces than on their trends. Lattman[4] comparing the results obtained from the field observations and those from the photographs suggests that there is a significant parallelism between the fracture traces and the bed rock joints. Judson and Andrews[5] from a study of a driftless area have shown that there is a marked coincidence in the strike of the stream valleys, including those small ones containing the first-order drainage lines of the slopes of hill ranges, and the joint pattern. Hence, it is very likely that the stream valleys here, which are only results of erosion by the drainage in those directions, are essentially controlled by joints in this area as well.

The importance of this study is to indicate how one can arrive at the trends of certain structural elements even when the area is thickly covered with vegetation and is inaccessible.

Thanks are due to the Ministry of Defence for permission to study the aerial photographs in the Survey of India Offices and to Dr. Y. R. Sarma for kindly suggesting the method of statistical analysis of the data obtained. The financial assistance of the Council of Scientific and Industrial Research to one of the authors (K. L. V. R.) is thankfully acknowledged.

Geology Department, K. L. V. RAMANA RAO.
Andhra University, R. VAIDYANADHAN.
Waltair, *December* 19, 1969.

---

1. Blanchet, P. H., *Bull. Am. Asso. Petro. Geol.*, 1957, **41**, 1748.
2. Wobber, J. F., *Photogr. Engg.*, 1967, **33**, 499.
3. Trainer, F. W. and Ellison, R. L., *Ibid.*, 1967, **33**, 190.
4. Lattman, L. H., *Ibid.*, 1958, **24**, 568.
5. Judson, S. and Andrews, G. W., *Jour. Geol.*, 1955, **63**, 328.

TWIN INVESTIGATION IN LEPROSY IN WEST BENGAL

THERE is some evidence that genetic factors might influence susceptibility and cause of leprosy. The blood groups seem to have some influence[1] and besides, family data seem to point to some family correlation of the type of leprosy. However, due to the high correlation of genetic and environmental factors, family investigation will not allow any definite conclusion as to the possible influence of heredity as a family correlation could also be explained by higher risk of infection.

Here, the twin method offers unique possibilities for research. Monozygotic and Dizygotic twins are generally living under the same conditions in their families. If Mz twins who are identical genetically, would show higher concordance in incidence and type of leprosy than Dz twins, this would be a strong argument in favour of genetical factors. If, on the other hand, not all Mz twins could be concordant as to leprosy, an analysis of discordant Mz twins would offer a unique chance of analysing the environmental conditions which influence differences in Mz twins. The well-known twin investigations on Tuberculosis[2] could serve as a guide for possible points of view.

A research programme was thus undertaken jointly by the Indian Statistical Institute,

Calcutta and University of Heidelberg, West Germany, during May 1969. The financial assistance came from both sources. The investigation was carried out by the author during May 1969 to October 1969, in the two districts of West Bengal, namely, Purulia and Bankura with the help of the local leprosy experts.

Our information on leprous twins mainly came from the following sources:

(*a*) All the in-patients of the two major leprosy hospitals, one in Purulia (The Leprosy Mission Home and Hospital) and the other in Bankura (Gouripore Leprosy Home) were asked as to whether they have twin brothers and sisters.

(*b*) Besides, all the out-patients' clinics situated in these two districts were visited within this period and the patients were asked the same question. On the availability of the twin information, we personally visited the places of residence of all leprous twin pairs. In this way, it was possible for us to cover several thousands of patients during this period of 6 months. The over-all frequency of twins among new borns in Indian population is not clearly known. It might be inferred that the frequency would not be too different from that of the other European population (1 in 80–90 births).

A total number of fifty leprous twin pairs could, thus, be available. We made it sure again, that for our study, the twin pair must fulfil the following conditions:

1. that both the members of the twin pair must be living at the time of our survey, whether living apart or living together;
2. at least one of them should be affected with the disease, any type of leprosy.

Every twin pair detected in this way was personally examined anthropologically and clinically by the author with the help of expert leprologists.

The first step of our study started with the following:

1. anthropometric measurements of the twin pair;
2. essential information related to their living condition, household, occupation and other sociological factors;
3. blood examination for determining the ABO and Rh groups and some very important biochemical tests and other genetical traits.
4. complete history of the disease, contact, and detailed disease characteristics.
5. Photographs—three to four views.

The above study could help us for the diagnosis.[3]

Result.—When the zygosity of the twin pair is established with the help of the above-mentioned genetical markers, the concordance and discordance rates on the basis of the type, incidence and disease characteristics of leprosy could be calculated. The following preliminary findings may throw some light on the problem in question:

	Observations	Chingleput series[4] (Md. Ali and Ramanujam, 1966) ($n = 40$)	Present series Chakravartti ($n = 50$)
1.	No. of judged monozygotic pairs	23	29
2.	No. of judged dizygotic pairs	17	21
3.	No. of Mz twin pairs both suffering from leprosy	19	11
4.	No. of Dz twin pairs both suffering from leprosy	3	2
5.	No. of Mz twin pairs both suffering from the same type of leprosy	17	10
6.	No. of Dz twin pairs both suffering from the same type of leprosy	1	2
7.	No. of Mz twin pairs both suffering from different type of leprosy	0	1

	Observations	Sex	Abs. No.
1.	Mz with same type of disease occurrence in both	MM	6
		FF	4
2.	Dz with same type of disease occurrence in both	MM	1
		MF	1
3.	Mz with one member affected	MM	10
		FF	8
4.	Dz with one member affected	MM	11
		MF	6
		FF	2
5.	Mz with different type of disease on both	MM	1

The details of the investigation will be published elsewhere.

Reader in Physical Anthropology, M. R. CHAKRAVARTTI.
Dept. of Anthropology,
Andhra University,
Waltair (A.P.), *December* 24, 1969.

---

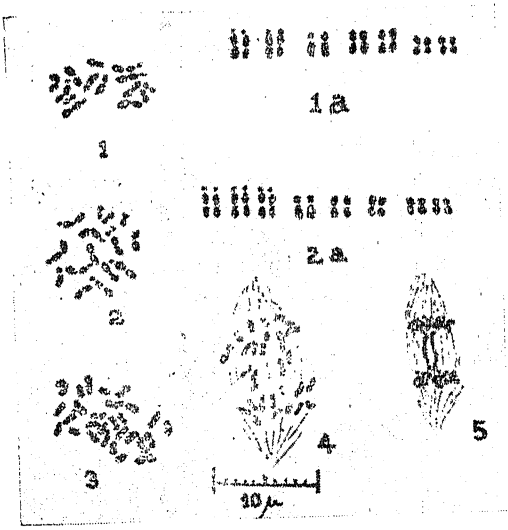
1. Vogel, F. and Chakravartti, M. R., "ABO blood groups and the type of leprosy in Indian population," *Humangenetik*, 1966, **3**, 186.
2. Verschuer, O. V., "Tuberkulose und Krebs bei Zwillingen" *Acta Genet.*, 1956, **6**, 103.
3. Stern, C., *Principles of Human Genetics*, Freeman and Co., London, 1960.
4. Mohamed Ali, P. and Ramanujam, K, "Leprosy in twins," *Int. J. Leprosy*, 1966, **34**, 405.

CYTOLOGICAL INVESTIGATIONS IN *ROSA LESCHENAULTIANA* W. & A.

THE basic chromosome number in the genus *Rosa* is seven ($x = 7$).[1,2] While a majority of the species remain at the diploid level ($2n = 14$), there are also various degrees of polyploid species, such as triploids, tetraploids, pentaploids, hexaploids and octoploids, occurring in nature. It is known that speciation in *Rosa* has been due to auto- as well as allo-polyploidy.[3]

The present investigation pertains to the cytological studies in *Rosa leschenaultiana* W. & A., both in the regular root tips and in the artificially induced callus tissues (obtained after ringing the stem by removing the peripheral band of tissues external to the xylem). The massive callus, which appears after three weeks at the upper cut-ends of the stem, and the root tips were fixed, separately, in 1 : 3 acetic alcohol for 3–24 hours. Following the schedule described earlier,[4] the squashes were made using aceto-orcein.

The normal diploid complement of chromosomes in *R. leschenaultiana* has been found to be 14 (Fig. 1). The chromosomes range from 1·5–3·0 microns in length. The karyotype analysis revealed (Fig. 1 *a*) the presence of (*a*) 2 pairs of long chromosomes (3 μ) with a median primary constriction and a satellite, (*b*) 2 pairs of medium-sized chromosomes (2·5 μ) with median constriction, (*c*) a pair of chromosomes of the same length with submedian constriction, and (*d*) 2 pairs of short chromosomes (1·5 μ) with median constriction.



FIGS. 1–5

A few cells were also found to contain 16 (Fig. 2) and 28 (Fig. 3) chromosomes. The karyotype analysis of the former indicated the occurrence of an additional pair of long chromosomes (Fig. 2 *a*). The occurrence of 16 chromosomes was found to be more in the callus than in the root tip cells; and none of the tetraploid cells was found to occur in the normal root tips but only in the callus preparations, apparently due to wound hormones.

Besides, a few abnormalities like unequal distribution of chromosomes at anaphase (Fig. 4) and the formation of chromatid bridges (Fig. 5) were found to occur rather frequently.

The aneuploid variations with sixteen chromosomes herein reported are to be attributed largely to the mitotic irregularities like the occurrence of chromosome laggards and unequal distribution of chromosomes during anaphase.

Botany Department, R. SAMPATHKUMAR.
Annamalai University,
Annamalainagar, *December* 20, 1969.

---

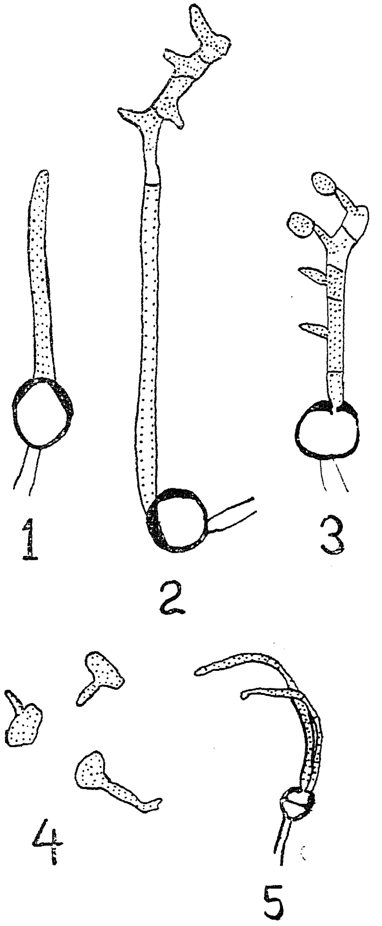
1. Erlanson, E. W., *New Phytol.*, 1938, **37**, 72.
2. Wylie, A. P., *Amer. Rose Ann.*, 1954, **39**, 36.
3. Hurst, C. C., *Proc. Roy. Soc. B*, 1931, **109**, 126.
4. Ayyangar, K. R. and Sampathkumar, R., *Curr. Sci.*, 1967, **36**, 470.

THE MODE OF GERMINATION OF TELIOSPORES OF *PUCCINIA HETEROSPORA*

THE rust fungus *Puccinia heterospora* Berk. and Curt. parasitizes the leaves of different species of *Sida* like *S. verconicæfolia*, *S. acuta*, *S. glutinosa* and *S. spinosa*. The present note deals with the mode of germination of the teliospores of this fungus.

The material was collected from Shivaji University campus area and Katyayani forest. Teliospores were germinated by hanging drop method.[1] Bacterial contamination which obstructed the healthy growth of the germ tubes was overcome by using 50 μg. per 100 ml. solution of chloramphenicol for smearing the spores on the slides.

The teliospores germinated readily within 6 to 8 hours at room temperature (26 to 28° C.) without any resting period and they remained viable for more than 10 days. The teliospores produced a typical four-celled basidium. Each cell of this basidium gave rise to a short sterigma which bore a single basidiospore (Figs. 1-3). Basidiospores germinated when still attached to the sterigma or even after detachment (Fig. 4). A few two-celled teliospores that were present as characteristic feature of *Puccinia heterospora* also germinated giving out two germ tubes, one from each cell (Fig. 5). Under excess moisture conditions prolongation of germ tubes and sterigmata occurred.



FIGS. 1-5. Fig. 1. Germinating teliospore, × 400. Fig. 2. Four-celled basidium with short sterigmata, × 400. Fig. 3. Four-sterigmate basidium with basidiospores, × 400. Fig. 4. Germinating basidiospores, × 600, Fig. 5. Two germ tubes from two-celled teliospore, × 150.

Morphologically the mode of germination of the teliospores of this fungus closely resembles that of *Puccinia purpurea*,[2] *P. thwitesii*,[3] *P. prainiana*[4] and many other species of *Puccinia*. Four-celled basidium is very common within the genus *Puccinia* with a few exceptions like *P. penniseti*[5] where it is two-celled.

The fungus on all the four species of *Sida* mentioned above exhibited the same germination pattern.

I am thankful to Dr. U. K. Kulkarni for guidance.

Department of Botany, S. N. KOTWAL.
Shivaji University,
Kolhapur (M.S.), *December* 16, 1969.

---

1. Thirumalachar, M. J. and Pavgi, M. S., *Indian Phytopath.*, 1950, **3**, 177.
2. Kulkarni, U. K., *Jour. Univ. Poona*, Sci. Tech. Sect., 1962, **24**, 145.
3. Payak, M. M., *Indian Phytopath.*, 1962, **15**, 37.
4. Kotwal, S. N. and Kulkarni, U. K., Unpublished work.
5. Kulkarni, U. K., *Trans. Brit. Mycol. Soc.*, 1958, **41** (i), 65.

CAPNODIASTRUM STYLOSPORUM (COOK) PETR., A NEW RECORD TO INDIA

DURING his visit to the forests of Coorg, Mysore State, India, the writer collected a sootymold-like fungus parasitizing leaves of *Trema orientalis* Blume. Microscopic examination of the affected leaves revealed the presence of a pycnidial fungus with superficial hyphopodiate mycelium and pycnidia with one-celled brown conidia, on the basis of which it was identified as a species of the form-genus *Capnodiastrum* Speg., which is the conidial state of the ascigerous fungus *Rhytidenglerula*. This fungus was identified as *Capnodiastrum stylosporum* on the basis of comparative studies. Being a rare fungus, not so far reported from India, a brief description is presented for ready reference.

Capnodiastrum stylosporum (Cook) Petr.
Petrak, F. 1952, Sydowia, 6 : 341.

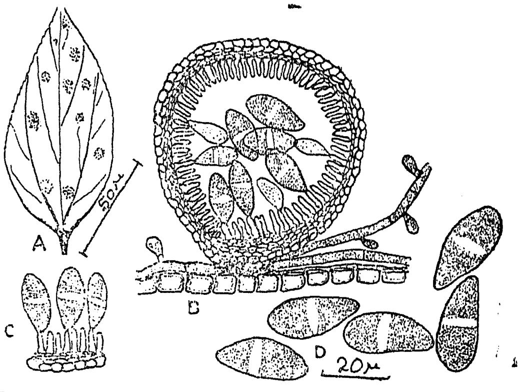


FIG. 1. A, habit; B, section of the pycnidium; C, conidiophores with conidia; D, conidia.

Colonies dark brown, isolated, 1–2 mm in diameter, hypophyllous. Mycelium superficial, dark brown, septate, hyphopodiate. Hyphopodia alternate, 2-celled, dark brown clavate, 8–10 × 2 [illegible]. Pycnidia superficial with subiculum, non-ostiolate, dark brown, spherical to globose, 80–120 μ diam. Conidiophores simple, cylindrical, in wall layers, hyaline, 6–10 μ long. Conidia dark brown, pyriform, with hyaline oval-shaped guttulum, one-celled, 28–32 × 12–16 μ.

Habit. Parasitic on the leaves of *Trema orientalis* Blume collected by Anahosur, K. H., at Coorg, India, on 12-2-1967, M.A.C.S. Herb. No. 339. No ascigerous stage was encountered in the collection.

The material of the above fungus is also deposited at Herb. Orientalis, New Delhi.

This is a new generic record to Indian fungi.

The author records his thanks to Prof. M. N. Kamat, for his encouragement and guidance, and to Dr. K. A. Pirozynski, formerly of C.M.I., Kew, for help in the identification of the fungus.

M.A.C.S. Res. Institute, K. H. Anahosur.
Poona-4 (India), *October* 21, 1969.

A NEW SPECIES OF *PYRICULARIA* ON BAJRA

During regular visits to the Agronomy Farm, College of Agriculture, Jobner, Rajasthan, over the past two years, the authors noticed the occurrence of a new leaf spot disease of bajra (*Pennisetum typhoides* (Stapf and Hubbard) in severe form. Microscopic examination of the disease revealed that it is caused by a species of the fungus *Pyricularia*.

The fungus was isolated on PDA and established in pure culture. The growth on PDA and oat meal agar medium is quite profuse, developing white mycelium which later turns greyish white to black. Sporulation on PDA and oat meal was profuse, and the spores formed were of the same shape as but slightly longer than those produced naturally on the host.

Pyricularia isolates from bajra, rice, and *Digitaria marginata* were used for pathogenicity and cross-inoculation experiments. The disease appeared within three days only on inoculated bajra plants and did not infect rice, *Digitaria marginata*, jowar, maize, and other grasses. In morphological characters, the conidia of bajra isolates are distinctly longer and more tapering than those of rice and *Digitaria marginata* isolates, and the conidia of rice isolates and *Digitaria marginata* isolates resemble closely (Fig. 1) but do not infect each other. As this *Pyricularia* differs in morphology and is host specific it may be designated a new species, *Pyricularia penniseti* Prasada and Goyal.

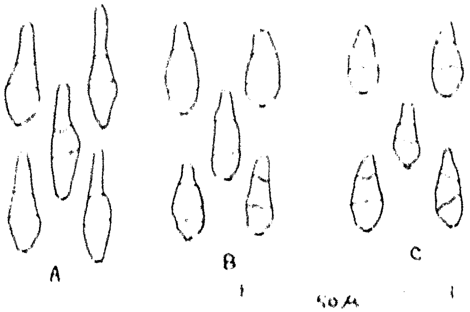


FIG. 1. A, Conidia of *Pyricularia penniseti* sp. nov. B, Conidia of *Pyricularia oryzae*. C, Conidia of *Digitaria marginata* isolates.

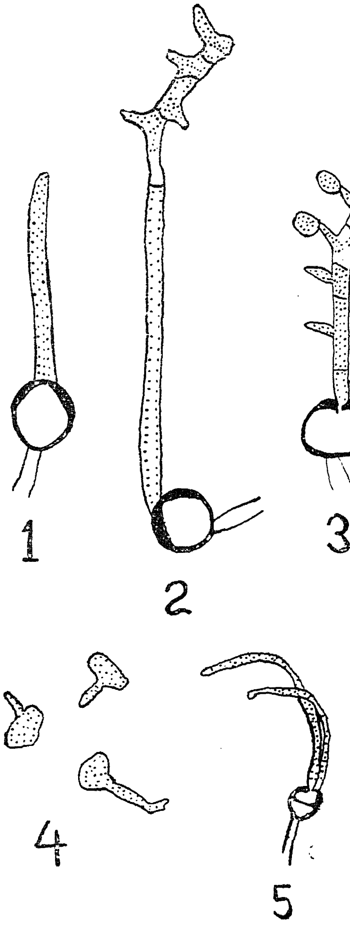
Pyricularia penniseti PRASADA AND GOYAL SP. NOV.

Leaf spots elongated or irregular, yellowish-brown when young and becoming dark brown or black with age, scattered, greyish-white centre bordered by deep brown margin and yellow halo, pinpoint to 15 mm. in diameter, coalescent, with 2–8 concentric rings giving the appearance of zones, bearing conidiophores and conidia on both the surfaces. Conidiophores in fascicles, 4–12 in number, loose, emerging through stomata, yellowish-brown, divergent, straight to variously curved, 2–3-septate, with distinct scars, geniculate, bearing conidia singly in scorpioid manner, rarely branched, sub-obtuse at apex, slightly broader at the base, 49·50–150 × 3·60–5·50 μ. Conidia hyaline, 3-celled, pyriform, narrow towards the apex, straight or slightly bent, obtuse to sub-obtuse at tip, with a small and distinct hilum at the base indicating the point of attachment, measuring 18·35–36·70 μ in length and 7·35–11·10 μ in width (mean 27·50 × 9·20 μ).

On leaves of *Pennisetum typhoides* Stapf. and Hubbard, College of Agriculture, Agronomy Farm, Jobner, Rajasthan, India, August 1967, leg. J. P. Goyal.

Pyricularia penniseti PRAS. AND GOYAL SP. NOV.

Foliorum maculae elongatae vel irregulares, luteolo-brunneae juniores, senescentes vero brunneae vel nigrae, dispersae, griseoalbae in centro circumdatae marginibus brunneis et corona lutea, ex puncto and 15 mm. diam. coalescentes, annulis 2–8 concentricis zonas still attached to the sterigma or even after detachment (Fig. 4). A few two-celled teliospores that were present as characteristic feature of *Puccinia heterospora* also germinated giving out two germ tubes, one from each cell (Fig. 5). Under excess moisture conditions prolongation of germ tubes and sterigmata occurred.



FIGS. 1-5. Fig. 1. Germinating teliospore, × 400. Fig. 2. Four-celled basidium with short sterigmata, × 400. Fig. 3. Four-sterigmate basidium with basidiospores, × 400. Fig. 4. Germinating basidiospores, × 600, Fig. 5. Two germ tubes from two-celled teliospore, × 150.

Morphologically the mode of germination of the teliospores of this fungus closely resembles that of *Puccinia purpurea*,[2] *P. thwitesii*,[3] *P. prainiana*[4] and many other species of *Puccinia*. Four-celled basidium is very common within the genus *Puccinia* with a few exceptions like *P. penniseti*[5] where it is two-celled.

The fungus on all the four species of *Sida* mentioned above exhibited the same germination pattern.

I am thankful to Dr. U. K. Kulkarni for guidance.

Department of Botany, S. N. KOTWAL.
Shivaji University,
Kolhapur (M.S.), *December* 16, 1969.

---

1. Thirumalachar, M. J. and Pavgi, M. S., *Indian Phytopath.*, 1950, **3**, 177.
2. Kulkarni, U. K., *Jour. Univ. Poona*, Sci. Tech. Sect., 1962, **24**, 145.
3. Payak, M. M., *Indian Phytopath.*, 1962, **15**, 37.
4. Kotwal, S. N. and Kulkarni, U. K., Unpublished work.
5. Kulkarni, U. K., *Trans. Brit. Mycol. Soc.*, 1958, **41** (i), 65.

CAPNODIASTRUM STYLOSPORUM (COOK) PETR., A NEW RECORD TO INDIA

DURING his visit to the forests of Coorg, Mysore State, India, the writer collected a sootymold-like fungus parasitizing leaves of *Trema orientalis* Blume. Microscopic examination of the affected leaves revealed the presence of a pycnidial fungus with superficial hyphopodiate mycelium and pycnidia with one-celled brown conidia, on the basis of which it was identified as a species of the form-genus *Capnodiastrum* Speg., which is the conidial state of the ascigerous fungus *Rhytidenglerula*. This fungus was identified as *Capnodiastrum stylosporum* on the basis of comparative studies. Being a rare fungus, not so far reported from India, a brief description is presented for ready reference.

Capnodiastrum stylosporum (Cook) Petr.
Petrak, F. 1952, Sydowia, 6 : 341.

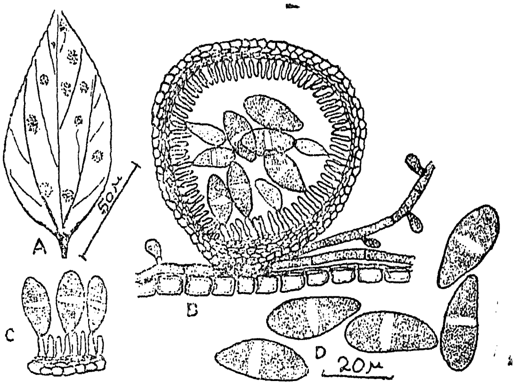


FIG. 1. A, habit; B, section of the pycnidium; C, conidiophores with conidia; D, conidia.

Colonies dark brown, isolated, 1-2 mm. in diameter, hypophyllous. Mycelium superficial, dark brown, septate, hyphopodiate. Hyphopodia alternate, 2-celled, dark brown clavate, 8-10 × 2 μ. Pycnidia superficial with subiculum, non-ostiolate, dark brown, spherical to globose, 80-120 μ diam. Conidiophores simple, cylindrical, in wall layers, hyaline, 6-10 μ long. Conidia dark brown, pyriform, with hyaline oval-shaped guttulum, one-celled, 28-32 × 12-16 μ.

Habit: Parasitic on the leaves of *Trema orientalis* Blume. collected by Anahosur, K. H., at Coorg, India, on 12-2-1967, M.A.C.S. Herb. No. 739. No ascigerous stage was encountered in this collection.

The material of the above fungus is also deposited at Herb. Orientalis, New Delhi.

This is a new generic record to Indian fungi.

The author records his thanks to Prof. M. N. Kamat, for his encouragement and guidance, and to Dr. K. A. Pirozynski, formerly of C.M.I., Kew, for help in the identification of the fungus.

M.A.C.S. Res. Institute, Poona-4 (India), *October* 21, 1969.   K. H. ANAHOSUR.

A NEW SPECIES OF *PYRICULARIA* ON BAJRA

DURING regular visits to the Agronomy Farm, College of Agriculture, Jobner, Rajasthan, over the past two years, the authors noticed the occurrence of a new leaf spot disease of bajra (*Pennisetum typhoides* Stapf. and Hubbard) in severe form. Microscopic examination of the disease revealed that it is caused by a species of the fungus *Pyricularia*.

The fungus was isolated on PDA and established in pure culture. The growth on PDA and oat meal agar medium is quite profuse, developing white mycelium which later turns greyish-white to black. Sporulation on PDA and oat meal was profuse, and the spores formed were of the same shape as but slightly longer than those produced naturally on the host.

Pyricularia isolates from bajra, rice, and *Digitaria marginata* were used for pathogenicity and cross-inoculation experiments. The disease appeared within three days only on inoculated bajra plants and did not infect rice, *Digitaria marginata*, jowar, maize, and other grasses. In morphological characters, the conidia of bajra isolates are distinctly longer and more tapering than those of rice and *Digitaria marginata* isolates, and the conidia of rice isolates and *Digitaria marginata* isolates resemble closely (Fig. 1) but do not infect each other. As this *Pyricularia* differs in morphology and is host specific it may be designated a new species, *Pyricularia penniseti* Prasada and Goyal.

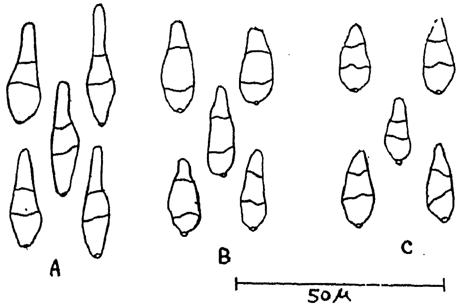


FIG. 1. A. Conidia of *Pyricularia penniseti* sp. nov. B. Conidia of *Pyricularia oryzæ*. C. Conidia of *Digitaria marginata* isolates.

Pyricularia penniseti PRASADA AND GOYAL SP. NOV.

Leaf spots elongated or irregular, yellowish-brown when young and becoming dark brown or black with age, scattered, greyish-white centre bordered by deep brown margin and yellow halo, pinpoint to 15 mm. in diameter, coalescent, with 2–8 concentric rings giving the appearance of zones, bearing conidiophores and conidia on both the surfaces. Conidiophores in fascicles, 4–12 in number, loose, emerging through stomata, yellowish-brown, divergent, straight to variously curved, 2–8-septate, with distinct scars, geniculate, bearing conidia singly in scorpioid manner, rarely branched, sub-obtuse at apex, slightly broader at the base, 49·50–150 × 3·60–5·50 μ. Conidia hyaline, tricelled, pyriform, narrow towards the apex, straight or slightly bent, obtuse to sub-obtuse at tip, with a small and distinct hilum at the base indicating the point of attachment, measuring 18·35–36·70 μ in length and 7·35–11·10 μ in width (mean 27·50 × 9·20 μ).

On leaves of *Pennisetum typhoides* Stapf. and Hubbard, College of Agriculture, Agronomy Farm, Jobner, Rajasthan, India, August, 1967, leg. J. P. Goyal.

Pyricularia penniseti PRAS. AND GOYAL SP. NOV.

Foliorum maculæ elongatæ vel irregulares, luteolo-brunneæ juniores, senescentes vero brunneæ vel nigræ, dispersæ, griseoalbæ in centro circumdatæ marginibus brunneis et corona lutea, ex puncto and 15 mm. diam. coalescentes, annulis 2–8 concentricis zonas

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4–12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. Prasada.
College of Agriculture, J. P. Goyal.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh, B and Mathur, S. C., *Indian Phytopath.*, 1952, 5 (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale Linn. *Sp. Pl.* 645, 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt.* & Brown, *Illust. Fl. N.E.U.S. & Canada*, 2 : 213, 1963; *Vasconcellos* in *Fl. Europ.* 1 : 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (–7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, [illegible] cm. long, higher ones linear-lanceolate, entire; all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm long (incl. 1–2 cm long peduncle); pedicels spreading, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·06 cm long; petals none; stamens 2, filaments 0·1 cm long; stigma sessile, capitate. Pod elliptic-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·25 × 0·15 cm.; seeds 2, reddish brown, subreniform, smooth, 0·1 cm long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West Bengal: Hooghly, Konnagar, *M. C. Biswas* 12 (CAL).

Notes. *L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.)], a Central Asiatic species; *L. virginicum* Linn., a native of North America, now adventive in Europe and Asia and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (vide Babu in *Bull. Bot. Surv. Ind.* 8 : 200, 1966) and *L. densiflorum* Schrad. also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem hairs clavate. Racemes axillary, short ... *L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent ... *L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised ... *L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire ... *L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. Babu.
Howrah-3, *January* 15, 1970. M. C. Biswas.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $ 26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1953 when the first structure was elucidated, and the recent demonstrations of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful to organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $ 11.75; £ 5 12 sh. 0 d.

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free-Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $ 10.00 in U.S.A.; Foreign $ 10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blattaria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4-12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh. B. and Mathur, S. C., *Indian Phytopath.*, 1952, **5** (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale Linn. *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt.* & Brown, *Illust. Fl. N.E.U.S. & Canada*, 2 : 213, 1963; *Vasconcellos* in *Fl. Europ.* 1 : 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (-7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm. long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm. long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm. long; petals none; stamens 2, filaments 0·1 cm. long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm. long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.]—a Central Asiatic species *L. virginicum* Linn.—a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (*vide* Babu in *Bull. Bot Surv Ind.* 8 : 200, 1966) and *L. densiflorum* Schrad.—also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short. —*L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent. —*L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised. —*L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire. —*L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1953 when the first structure was elucidated, and the recent demonstrations of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin.

C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $11.75; £5 12*sh.* 0*d.*

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $10.00 in U.S.A.; Foreign $10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blataria by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey-Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis.

C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4-12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. Prasada.
College of Agriculture, J. P. Goyal.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh. B. and Mathur, S. C., *Indian Phytopath.*, 1952, 5 (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale **Linn.** *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt. & Brown, Illust. Fl. N.E.U.S. & Canada*, 2 : 213, 1963; *Vasconcellos* in *Fl. Europ.* 1 : 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2–pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (-7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm. long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm. long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm. long; petals none; stamens 2, filaments 0·1 cm. long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm. long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.]—a Central Asiatic species *L. virginicum* Linn.—a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (*vide* Babu in *Bull. Bot Surv Ind.* 8 : 200, 1966) and *L. densiflorum* Schrad.—also a native of North America, but these four closely related species can be distinguished in the following way :

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short. —*L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent. —*L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised. —*L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire. —*L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. Babu.
Howrah-3, *January* 15, 1970. M. C. Biswas.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $ 26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1953 when the first structure was elucidated, and the recent demonstration of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $ 11.75; £ 5 12 *sh*. 0 *d*.

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $ 10.00 in U.S.A.; Foreign $ 10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blattaria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4-12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh. B. and Mathur, S. C., *Indian Phytopath.*, 1952, **5** (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale Linn. *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt.* & Brown, *Illust. Fl. N.E.U.S. & Canada*, 2: 213, 1963; *Vasconcellos* in *Fl. Europ.* 1: 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (-7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm. long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm. long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm. long; petals none; stamens 2, filaments 0·1 cm. long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm. long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.]—a Central Asiatic species *L. virginicum* Linn.—a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (*vide* Babu in *Bull. Bot Surv Ind.* 8: 200, 1966) and *L. densiflorum* Schrad.—also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short. —*L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent. —*L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised. —*L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire. —*L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1958 when the first structure was elucidated, and the recent demonstration of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free-Radical Chemistry (Vol. 1). Edited by E. S. Huyser (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $11.75; £5 12 *sh.* 0 *d.*

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free-Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $10.00 in U.S.A.; Foreign $10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blattaria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4-12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh, B. and Mathur, S. C., *Indian Phytopath.*, 1952, **5** (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale **Linn.** *Sp. Pl.* 645, 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt. & Brown, Illust. Fl. N.E.U.S. & Canada*, 2: 213, 1963; *Vasconcellos* in *Fl. Europ.* 1: 332, 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (–7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm long peduncle); pedicels subterete, 0·15–0·2 cm long during anthesis, 0·25–0·3 cm long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm long; petals none; stamens 2, filaments 0·1 cm long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish brown, subreniform, smooth, 0·1 cm long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [*L. ruderale* sensu Hook. f. & Anders. (non Linn.)] a Central Asiatic species, *L. virginicum* Linn. a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (vide Babu in *Bull. Bot. Surv. Ind.* 8: 200, 1966) and *L. densiflorum* Schrad. also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short
   L. apetalum Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
   2. Petals present, longer than sepals. Cotyledons accumbent
      L. virginicum Linn.
   2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
      3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised
         L. densiflorum Schrad.
      3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire
         L. ruderale Linn.

Grateful thanks are due to Dr M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1953 when the first structure was elucidated, and the recent demonstrations of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota, and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

The book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $11.75; £5 12 *sh.* 0 *d.*

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practicing scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $10.00 in U.S.A.; Foreign $10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blattaria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4–12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh, B. and Mathur, S. C., *Indian Phytopath.*, 1952, 5 (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale **Linn.** *Sp. Pl.* 645, 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt.* & Brown, *Illust. Fl. N.E.U.S. & Canada*, 2: 213, 1963; *Vasconcellos* in *Fl. Europ.* 1: 332, 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (–7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm. long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm long; petals none; stamens 2, filaments 0·1 cm long; stigma sessile, capitate. Pod ellipsoid oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm. long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.)] a Central Asiatic species, *L. virginicum* Linn. a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (vide Babu in *Bull. Bot. Surv. Ind.* 8: 200, 1966) and *L. densiflorum* Schrad. also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short
L. apetalum Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long
    2. Petals present, longer than sepals. Cotyledons accumbent.
    L. virginicum Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
    3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised
    L. densiflorum Schrad.
    3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire
    L. ruderale Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1953 when the first structure was elucidated, and the recent demonstration of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free Radical Chemistry (Vol. I). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $11.75; £5 12 sh. 0 d.

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free-Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $10.00 in U.S.A.; Foreign $10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blattaria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey-Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4-12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh. B. and Mathur, S. C., *Indian Phytopath.*, 1952, 5 (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale Linn. *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt. & Brown, Illust. Fl. N.E.U.S. & Canada*, 2 : 213, 1963; *Vasconcellos* in *Fl. Europ.* 1 : 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (-7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm. long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm. long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm. long; petals none; stamens 2, filaments 0·1 cm. long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm. long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.]—a Central Asiatic species *L. virginicum* Linn.—a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (*vide* Babu in *Bull. Bot Surv Ind.* 8 : 200, 1966) and *L. densiflorum* Schrad.—also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short. —*L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent. —*L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised. —*L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire. —*L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1953 when the first structure was elucidated, and the recent demonstration of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $11.75; £ 5 12 sh. 0 d.

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $10.00 in U.S.A.; Foreign $10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blataria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4–12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. Prasada.
College of Agriculture, J. P. Goyal.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh, B. and Mathur, S. C., *Indian Phytopath.*, 1952, **5** (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale **Linn.** *Sp. Pl.* 645, 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt. & Brown, Illust. Fl. N.E.U.S. & Canada*, 2: 213, 1963; *Vasconcellos* in *Fl. Europ.* 1: 332, 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (–7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or sub-acute at apex, serrate, pinnatifid, 1–2 cm long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm long; petals none; stamens 2, filaments 0·1 cm. long; stigma sessile, capitate. Pod ellipsoid oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes. *L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [*L. ruderale* sensu Hook. f. & Anders. (non Linn.)] a Central Asiatic species *L. virginicum* Linn., a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (vide Babu in *Bull. Bot. Surv. Ind.* 8: 200, 1966) and *L. densiflorum* Schrad. also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short ... *L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present, not clavate. Racemes lateral, long
    2. Petals present, longer than sepals. Cotyledons accumbent ... *L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised ... *L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire ... *L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. Babu.
Howrah-3, *January* 15, 1970. M. C. Biswas.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $ 26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1958 when the first structure was elucidated, and the recent demonstrations of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free-Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $ 11.75; £ 5.12 *sh.* 0 *d.*

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry,* consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free-Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $ 10.00 in U.S.A.; Foreign $ 10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blataria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey-Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4-12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh. B. and Mathur, S. C., *Indian Phytopath.*, 1952, **5** (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale Linn. *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt.* & Brown, *Illust. Fl. N.E.U.S. & Canada*, 2 : 213, 1963; *Vasconcellos* in *Fl. Europ.* 1 : 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (-7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm. long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm. long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm. long; petals none; stamens 2, filaments 0·1 cm. long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm. long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.]—a Central Asiatic species *L. virginicum* Linn.—a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (*vide* Babu in *Bull. Bot Surv Ind.* 8 : 200, 1966) and *L. densiflorum* Schrad.—also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short. —*L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent. —*L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised. —*L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire. —*L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $ 26.50.

Remarkable progress has been made in the field of cyclopentanoid monoterpenes since 1953 when the first structure was elucidated, and the recent demonstration of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentanoid monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

The book will be found useful to organic chemists, pharmacologists, medicinal chemists, biochemists, and investigators interested in products of natural origin. C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $ 11.75; £ 5-12 sh. 0 d.

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During the same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free-Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $ 10.00 in U.S.A.; Foreign $ 10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blataria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4–12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh, B and Mathur, S. C., *Indian Phytopath.*, 1952, 5 (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f. & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale **Linn.** *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders. 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt. & Brown, Illust. Fl. N.E.U.S. & Canada*, 2: 213, 1963; *Vasconcellos* in *Fl. Europ.* 1: 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (–7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1–2 cm long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm long peduncle); pedicels subterete, 0·1–0·2 cm long during anthesis, 0·25–0·3 cm long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm long; petal none; stamens 2, filaments 0·1 cm long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish brown, subreniform, smooth, 0·1 cm long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadside.

Specimens examined: West Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes. *L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.)] a Central Asiatic species, *L. virginicum* Linn. a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (vide Babu in *Bull. Bot. Surv. Ind.* 8: 200, 1966) and *L. densiflorum* Schrad. also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short
   L. apetalum Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long
   2. Petals present, longer than sepals. Cotyledons accumbent
      L. virginicum Linn.
   2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
      3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised
         L. densiflorum Schrad.
      3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire
         L. ruderale Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $26.50.

Remarkable progress has been made in the field of cyclopentanoid monoterpenes since 1953 when the first structure was elucidated, and the recent demonstrations of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentanoid monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of the volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

The book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin.
C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $11.75; £ 5.12 *sh.* 0*d.*

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During the same period, the increase in volume of scientific literature has left most practicing scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.
C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $ 10.00 in U.S.A.; Foreign $ 10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blattaria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis.
C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4–12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. Prasada.
College of Agriculture, J. P. Goyal.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh, B. and Mathur, S. C., *Indian Phytopath.*, 1952, 5 (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale Linn. *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt.* & Brown, *Illust. Fl. N.E.U.S. & Canada*, 2: 213, 1963; *Vasconcellos* in *Fl. Europ.* 1: 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (–7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1–2 cm long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm long (incl. 1–2 cm long peduncle); pedicels subterete, 0·1–0·2 cm long during anthesis, 0·25–0·3 cm long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm long; petals none; stamens 2, filaments 0·1 cm long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm; seeds reddish brown, subreniform, smooth, 0·1 cm long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes. *L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.)] a Central Asiatic species; *L. virginicum* Linn., a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (vide Babu in *Bull. Bot. Surv. Ind.* 8: 200, 1966) and *L. densiflorum* Schrad., also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem hairs clavate. Racemes axillary, short
L. apetalum Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent
    L. virginicum Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
    3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate incised
    L. densiflorum Schrad.
    3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire
    L. ruderale Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. Babu.
Howrah-3, *January* 15, 1970. M. C. Biswas.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1953 when the first structure was elucidated, and the recent demonstration of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $11.75; £5.12 *sh.* 0 *d.*

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry*, consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free-Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $10.00 in U.S.A.; Foreign $10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blattaria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey-Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

similantibus, producentes conidiophora et conidia in utraque pagina. Conidiophora fasciculata, 4-12 numero, laxa, emergentia per stomata, luteolo-brunnea, divergentia recta vel varie curvata, 2–8 septata, cicatricibus distinctis, geniculata, producentia conidia singula modo scorpioideo, raro ramosa, sub-obtusa ad apicem, paulo latiora ad basin, 49·50–150 × 3·60–5·50 μ. Conidia hyalina, 3-cellularia, pyriformia, ad apicem augusta, vel paulum curvata, obtusa vel sub-obtusa ad apicem ornata hilo distincto ad basin monstrante punctum unionis, 18·35–36·70 μ longa, 7·35–11·10 μ lata (mediet. 27·50 × 9·20 μ).

Typum legit J. P. Goyal in foliis *Penniseti typhoidis* Stapf. et Hubbard, in collegio agriculturæ, in campo experimentali, ad Jobner, in Rajasthania mense augusto anni 1967. Type IMI No. 143518.

Mehta *et al.* (1952) had noticed this disease at Kanpur in 1948 on leaves of bajra plants that were affected by 'downy mildew' and on healthy plants in 1952.

Dept. of Plant Pathology, R. PRASADA.
College of Agriculture, J. P. GOYAL.
Jobner, Rajasthan, *November* 29, 1969.

---

1. Mehta, P. R., Singh. B. and Mathur, S. C., *Indian Phytopath.*, 1952, **5** (2), 140.

LEPIDIUM RUDERALE LINN. (BRASSICACEAE) IN INDIA

Lepidium ruderale Linn. (non sensu Hook. f & Anders.)—a native of Europe, introduced and naturalized in North America—is now recorded here for the first time in India from West-Bengal. A concise description with critical notes is provided here.

Lepidium ruderale Linn. *Sp. Pl.* 645. 1753 (non sensu Hook. f. & Anders, 1872); *Thell. Gatt. Lepidium* 135, 1906; Gleason, *New Britt. & Brown, Illust. Fl. N.E.U.S. & Canada,* 2: 213, 1963; *Vasconcellos* in *Fl. Europ.* 1: 332. 1964.

Erect-ascending, simple or often branched from the base, annual-biennial herbs. Stems glabrous or short-hairy, 10–30 cm. tall. Basal leaves on long petioles, obovate-elliptic in outline, 1–2-pinnatifid-pinnatisect, with an oblanceolate-lanceolate or elliptic, serrate-dentate subacute terminal lobe, 1–5 (-7) cm. long, middle ones sessile, lanceolate-narrowly oblong, narrowed to the base, obtuse or subacute at apex, serrate, pinnatifid, 1·5–2 cm. long, higher ones linear-lanceolate, entire, all leaves hairy or glabrous. Flowers in glabrous or short-hairy, elongate, ebracteate, lateral racemes of 4–10 cm. long (incl. 1–2 cm. long peduncle); pedicels subterete, 0·15–0·2 cm. long during anthesis, 0·25–0·3 cm. long in fruiting; sepals 4, oblong, with a few long hairs at the top, 0·05–0·07 cm. long; petals none; stamens 2, filaments 0·1 cm. long; stigma sessile, capitate. Pod ellipsoid-oblong, shallowly notched at apex, winged at the top, longer than broad, 0·2–0·22 × 0·18 cm.; seeds reddish-brown, subreniform, smooth, 0·1 cm. long; cotyledons incumbent.

Flowers and fruits: April to June.

A rare weed of waste places and roadsides.

Specimens examined: West-Bengal: Hooghly, Konnagar, *M.C. Biswas* 12 (CAL).

Notes.—*L. ruderale* Linn. is closely allied to *L. apetalum* Willd. [= *L. ruderale* sensu Hook. f. & Anders. (non Linn.]—a Central Asiatic species *L. virginicum* Linn.—a native of North America, now adventive in Europe and Asia, and has often been erroneously identified as *L. ruderale* Linn. in Indian herbaria (*vide* Babu in *Bull. Bot Surv Ind.* 8: 200, 1966) and *L. densiflorum* Schrad.—also a native of North America, but these four closely related species can be distinguished in the following way:

1. Leaf-base semi-amplexicaul. Stem-hairs clavate. Racemes axillary, short. —*L. apetalum* Willd.
1. Leaf-base attenuate, not semi-amplexicaul. Stem-hairs, if present not clavate. Racemes lateral, long.
    2. Petals present, longer than sepals. Cotyledons accumbent. —*L. virginicum* Linn.
    2. Petals absent, if present, then shorter than sepals. Cotyledons incumbent.
        3. Pod 0·3–0·4 × 0·25–0·3 cm. Upper leaves sharply acute, serrate-incised. —*L. densiflorum* Schrad.
        3. Pod 0·2–0·25 × 0·15–0·2 cm. Upper leaves obtuse or subacute, entire. —*L. ruderale* Linn.

Grateful thanks are due to Dr. M. P. Nayar, Keeper, Central National Herbarium, Howrah, for his encouragement and suggestions.

Central National Herbarium, C. R. BABU.
Howrah-3, *January* 15, 1970. M. C. BISWAS.

REVIEWS AND NOTICES OF BOOKS

Cyclopentanoid Terpene Derivatives. Edited by W. I. Taylor and A. R. Battersby. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 432. Price $ 26.50.

Remarkable progress has been made in the field of cyclopentane monoterpenes since 1958 when the first structure was elucidated, and the recent demonstrations of the importance of these natural products as biosynthetic intermediates have still further increased research activity in this area. It was because of the intense current interest in the chemistry and biochemistry of cyclopentane monoterpenes that they were selected for inclusion in this series. Each section is written by an author of international reputation who is an outstanding contributor to original research in the area he covers.

The contents of this volume are: 1. The Iridoid Glycosides and Similar Substances, by James M. Bobbitt and K. P. Segebarth; 2. Picrotoxin, by Carmine J. Coscia; 3. Insect Terpenoids and Nepetalactone, by G. W. K. Cavill; 4. Monoterpene Alkaloids, by W. C. Wildman, J. Le Men, and in Part K. Wiesner; 5. Lower Furanoterpenes, by T. Kubota; and 6. Sesquiterpene Alkaloids, by O. E. Edwards.

This book will be found useful by organic chemists, pharmacologists, medicinal chemists, biochemists, and bioengineers interested in products of natural origin. C. V. R.

Methods in Free-Radical Chemistry (Vol. 1). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 208. Price $ 11.75; £ 5.12 *sh.* 0 *d.*

The spectrum of chemists aware of the importance of free radicals as reaction intermediates has increased significantly in the past two decades. During this same period, the increase in volume of scientific literature has left most practising scientists overwhelmed. A review of the literature would be too time-consuming for many readers. Of greater value is an interpretative review by an expert who not only knows where to find the pertinent literature, but is able to evaluate it critically.

This series, *Methods in Free-Radical Chemistry,* consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory. They were encouraged to be subjective and to regard this particular writing effort as a vehicle for expressing their own opinions concerning their field of specialization.

The chapters dealt with in this volume are: 1. Free-Radical Study by Electron Paramagnetic Resonance, by Larry Kevan; 2. Free-Radicals and Photochemical Reactions, by Douglas C. Neckers; and 3. Free-Radical Chlorination of Organic Molecules, by Marvin L. Poutsma.

C. V. R.

Annual Review of Entomology (Vol. 15). Edited by Ray F. Smith and Thomas E. Mittler. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California), 1970. Pp. vii + 502. Price $ 10.00 in U.S.A.; Foreign $ 10.50.

Volume 15 of this well-known series contains the following articles: Recent Advances in Insect Population Dynamics, by G. C. Varley and G. R. Gradwell; The Ecology of Stream Insects, by H. B. N. Hynes; Insect Mimicry, by Carl W. Rettenmeyer; Evolution and Taxonomic Significance of Reproduction in Blataria, by Louis M. Roth; Interpretations of Quaternary Insect Fossils, by G. R. Coope; The Structure of Arthropod Chemoreceptors, by Eleanor H. Slifer; Honey-Bee Nutrition, by Mykola H. Haydak; Biosystematics of the Embioptera, by Edward S. Ross; Physiology of Insect Hearts, by Frances V. McCann; Biological Rhythms in Terrestrial Arthropods, by A. S. Danilevsky, N. I. Goryshin, and V. P. Tyshchenko; Recent Advances in Insect Pathology, by Jaroslav Weiser; Mode of Action of Pyrethroids, Nicotinoids, and Rotenoids, by Izuru Yamamoto; Entomology of the Cocoa Farm, by Dennis Leston; Pome Fruit Pests and Their Control, by Harold F. Madsen and C. V. G. Morgan; Ultralow Volume Applications of Concentrated Insecticides in Medical and Veterinary Entomology, by C. S. Lofgren; Mite Transmission of Plant Viruses, by G. N. Oldfield; Resistance of Ticks to Chemicals, by R. H. Wharton and W. J. Roulston; and Mycoplasma and Phytarboviruses as Plant Pathogens Persistently Transmitted by Insects, by R. F. Whitcomb and R. E. Davis. C. V. R.

Basic Infrared Spectroscopy. By J. H. Van der Maas. (Heyden & Son Ltd., Spectrum House, Alderton Crescent, London N.W. 4), 1969. Pp. 108. Price £ 1.10.0; $ 3.50; DM 13.50.

Infrared spectroscopy has become an indispensable tool in organic chemistry. In its application, especially to macromolecules, practice has far outrun theory. Interpretation of the spectra of large molecules involves theoretical methods which are often different from those applicable to small molecules. The booklet provides a reasoned approach to this aspect of the subject and will act as a guide to those starting infrared spectroscopy. Besides, the appendices on typical band contours, correlation charts, and infrared absorption frequencies of functional groups will be of ready help to graduate workers. A. S. G.

Physician's Book Compendium. Editor: Max Celnick. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1970. Pp. 846. Price $ 29.50.

This *Compendium* is an indispensable reference volume to physicians who would like to keep abreast of times in the rapidly expanding field of medical knowledge and medical information. It is a comprehensive guide to medical books in print. More than 10,000 books now in print are listed and they include besides medical texts, books on topics of general interest to the medical profession, such as doctor-patient relations, forensic medicine, nutrition, exercise, and so on.

The basic divisions of the *Compendium* are by medical specialty. Within each specialty, there are sub-specialties under each of which are listed the books giving the author publisher and in many cases, a brief description of the contents.

Supplements to this 1970 *Compendium* will be issued periodically to include new publications. A. S. G.

ANNOUNCEMENTS

First International Mycological Congress

Arrangements are being made to hold the First International Mycological Congress from 7 to 16 September 1971 at Exeter, Devon, where accommodation will be available in the University Halls of Residence.

The main feature of the programme will be a series of broadly based symposia with invited speakers. These will be grouped into seven sections: Structure and Morphogenesis, Cytology and Genetics, Taxonomy, Physiology and Biochemistry, Industrial and Applied Mycology, Ecology, Symbiosis and Pathogenicity. In addition there will be many less formal meetings and ample opportunities for the exchange of ideas.

Further details may be obtained from Professor J. Webster, Secretary, First International Mycological Congress, University of Exeter, Exeter, Devon, England.

ERRATUM

Curr. Sci., 1969, 38, 510, Line 1:
For "*m*-Menth"
read "*m*-Mentha"

Curr. Sci., 1970, 39:
(1) Page 220, Column 1, Line 27 from top
Instead of Little Rann of Kutch off Kharagodha *Read* 10′ N., Long. 71° 39′ E.), District Kutch.
(2) Page 221, Column 2, Line 1
Instead of 34 *Read* 32.
(3) Page 222, References
2. Singh, G., *Indian Geohydrology*, 1967, 3 (1), 111.

Books Received

The Geological Society of America

Memoir No. 116—Studies in Volcanology—A Memoir in Honor of Howel Williams. Edited by R. R. Coats, R. L. Hay and C. A. Anderson. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. 678. Price $ 19.25.

Memoir No. 117—Bibliography of Fossil Vertebrates. Edited by C. L. Camp, H. J. Allison, R. H. Nichols and H. McGinnis, 1968. Pp. xlii + 644. Price $ 14.54.

Special Paper 98: A Catalog of Analyzed Calciferous and Subcalciferous Amphiboles together with their Nomenclature and Associated Minerals. By Bernard E. Leak, 1968. Pp. vi + 195. Price $ 7.50.

Special Paper 99: Tectonic, Plutonic and Metamorphic History of the Central Kootenary Arc British Columbia, Canada, 1968. Pp. 94. Price $ 6.00.

Special Paper 112: Pleistocene Recent Stratigraphy Evolution and Development of the Apalachicola, Coast, Florida. By J. E. Schnable and H. Grant Goodell, 1968. Pp. viii + 72. Price $ 2.75.

2048-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

DEW POINT TEMPERATURES OVER THE WORLD AND THEIR IMPORTANCE TO INDIAN SHIPPING

C. RAMASWAMY

C/o The Observatory, Lodi Road, New Delhi-3

ABSTRACT

It is pointed out that dew point temperature measurements are very important for the efficient management of cargo ventilation in Indian ships and for the prevention of sweat-damage to cargo when the ships undertake long voyages around the world.

Maps of Monthly Mean Dew point temperatures at sea level over the globe between 35° N and 60° S in January, April, July and October are presented and discussed with reference to the Indian Shipping routes.

INTRODUCTION

THERE are a number of ways of defining the humid state of the atmosphere and the term "Dew point" is one of the ways of defining it. For the purpose of this article, the dew point may be defined as the temperature at which the moisture present in any sample of air is just sufficient to saturate it. If the sample of air is cooled below this critical temperature which is referred to as the dew point temperature or simply as the dew point, the air cannot hold all the water vapour which was initially in it and consequently, the excess of water vapour will condense into droplets of water.

To illustrate the significance of the dew point in cargo ventilation problems, let us give an example. Suppose, in the month of July, a certain type of cargo is stowed into a hold in a ship in Bombay which is to proceed to Fremantle in South Australia and that it is *not* subject to ventilation during the voyage. Also suppose that the dew point temperature of the air inside the cargo at Bombay was 25° C. Now, July is a mid-winter month in the southern hemisphere. Consequently, after the ship crosses the equator and approaches Australia, the temperature of the outside air as well as of the surrounding sea water progressively decreases and the ship's boards become correspondingly colder by thermal conduction. When the temperature of the board-side falls below 25° C the original dew point of the air in the ship's hold the air in contact with the board-side inside the ship's hold, cannot retain the same amount of water-vapour as it did when the ship was in Bombay. Consequently, the excess of water-vapour condenses on the board-side (and on decks or ceilings) and the cargo may get wet either by direct contact or by the water dropping down. The water, which thus wets the cargo and enters into it, is referred to by seamen as "sweating" of the cargo.

Sweat on cargo can also be caused by moisture arising from the cargo itself as in the case of fruits, vegetables, etc. Also some types of cargo such as jute, wool, cotton and hides are "hygroscopic"; they have an affinity for moisture which is so *great* that they can absorb moisture even from air whose relative humidity is not very high. Such materials also sweat inside the ship's hold.

Sweating of cargo can also be caused by faulty ventilation procedures. For instance, certain types of cargo emit foul smell or exude poisonous vapours. In order to get rid of these odours and gases, seamen have necessarily to employ ventilation (Thomas, 1961). They usually admit fresh clean air from the outside atmosphere and allow the foul air inside the cargo space to escape through the discharge-vents. Now if the *dry bulb temperature* of the air inside the cargo space is initially say 15° C, and the air from the outside atmosphere admitted by ventilation has a *dew point* of 20° C, the admitted air cannot retain all the water vapour it held initially and at least some of the water vapour will be precipitated as sweat on the cargo.

Seamen are also aware of another type of danger to cargo, namely, that due to heat internally generated within certain types of cargo, *e.g.*, coal, hay and wool if wet or damp (Thomas, 1961). The heat generated in such cases, if left unchecked, may lead to spontaneous combustion and outbreak of fire, resulting in the loss of the ship, not to mention the loss of the cargo. For removing the heat generated, seamen have to employ ventilation. But this very ventilation can cause sweat-hazards if it is inappropriately employed in a meteorological situation of the type explained in the preceding paragraph.

Basic Infrared Spectroscopy. By J. H. Van der Maas. (Heyden & Son Ltd., Spectrum House, Alderton Crescent, London N.W. 4), 1969. Pp. 108. Price £ 1.10.0 ; $ 3.50 ; DM 13.50.

Infrared spectroscopy has become an indispensable tool in organic chemistry. In its application, especially to macromolecules, practice has far outrun theory. Interpretation of the spectra of large molecules involves theoretical methods which are often different from those applicable to small molecules. The booklet provides a reasoned approach to this aspect of the subject and will act as a guide to those starting infrared spectroscopy. Besides, the appendices on typical band contours, correlation charts, and infrared absorption frequencies of functional groups will be of ready help to graduate workers. A. S. G.

Physician's Book Compendium. Editor: Max Celnick. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1970. Pp. 846. Price $ 29.50.

This *Compendium* is an indispensable reference volume to physicians who would like to keep abreast of times in the rapidly expanding field of medical knowledge and medical information. It is a comprehensive guide to medical books in print. More than 10,000 books now in print are listed and they include besides medical texts, books on topics of general interest to the medical profession, such as doctor-patient relations, forensic medicine, nutrition, exercise, and so on.

The basic divisions of the *Compendium* are by medical specialty. Within each specialty, there are sub-specialties under each of which are listed the books giving the author publisher and in many cases, a brief description of the contents.

Supplements to this 1970 *Compendium* will be issued periodically to include new publications. A. S. G.

ANNOUNCEMENTS

First International Mycological Congress

Arrangements are being made to hold the First International Mycological Congress from 7 to 16 September 1971 at Exeter, Devon, where accommodation will be available in the University Halls of Residence.

The main feature of the programme will be a series of broadly based symposia with invited speakers. These will be grouped into seven sections: Structure and Morphogenesis, Cytology and Genetics, Taxonomy, Physiology and Biochemistry, Industrial and Applied Mycology, Ecology, Symbiosis and Pathogenicity. In addition there will be many less formal meetings and ample opportunities for the exchange of ideas.

Further details may be obtained from Professor J. Webster, Secretary, First International Mycological Congress, University of Exeter, Exeter, Devon, England.

ERRATUM

Curr. Sci., 1969, 38, 510, Line 1:
For "*m*-Menth"
read "*m*-Mentha"

Curr. Sci., 1970, 39:

(1) Page 220, Column 1, Line 27 from top
Instead of Little Rann of Kutch off Kharagodha *Read* 10′ N., Long. 71° 39′ E.), District Kutch.

(2) Page 221, Column 2, Line 1
Instead of 34 *Read* 32.

(3) Page 222, References
2. Singh, G., *Indian Geohydrology*, 1967, 3 (1), 111.

Books Received

The Geological Society of America

Memoir No. 116—Studies in Volcanology—A Memoir in Honor of Howel Williams. Edited by R. R. Coats, R. L. Hay and C. A. Anderson. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. 678. Price $ 19.25.

Memoir No. 117—Bibliography of Fossil Vertebrates. Edited by C. L. Camp, H. J. Allison, R. H. Nichols and H. McGinnis, 1968. Pp. xlii + 644. Price $ 14.54.

Special Paper 98: A Catalog of Analyzed Calciferous and Subcalciferous Amphiboles together with their Nomenclature and Associated Minerals. By Bernard E. Leak, 1968. Pp. vi + 195. Price $ 7.50.

Special Paper 99: Tectonic, Plutonic and Metamorphic History of the Central Kootenary Arc British Columbia, Canada, 1968. Pp. 94. Price $ 6.00.

Special Paper 112: Pleistocene Recent Stratigraphy Evolution and Development of the Apalachicola, Coast, Florida. By J. E. Schnable and H. Grant Goodell, 1968. Pp. viii + 72. Price $ 2.75.

2048-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

DEW POINT TEMPERATURES OVER THE WORLD AND THEIR IMPORTANCE TO INDIAN SHIPPING

C. RAMASWAMY

C/o The Observatory, Lodi Road, New Delhi-3

ABSTRACT

It is pointed out that dew point temperature measurements are very important for the efficient management of cargo ventilation in Indian ships and for the prevention of sweat damage to cargo when the ships undertake long voyages around the world.

Maps of Monthly Mean Dew point temperatures at sea-level over the globe between 75° N and [illegible]° S in January, April, July and October are presented and discussed with reference to the Indian Shipping routes.

INTRODUCTION

THERE are a number of ways of defining the humidity of the atmosphere and the term 'Dew point' is one of the ways of defining it. For the purposes of this article, the dew point may be defined as the temperature at which the moisture present in any sample of air is just sufficient to saturate it. If the sample of air is cooled below this critical temperature which is referred to as the dew point temperature or simply as the dew point, the air cannot hold all the water vapour which was initially in it and consequently, the excess of water vapour will condense into droplets of water.

To illustrate the significance of the dew point in cargo ventilation problems, let us give an example. Suppose in the month of July, a certain type of cargo is stowed into a hold in a ship in Bombay which is to proceed to Fremantle in South Australia and that it is not subject to ventilation during the voyage. Also suppose that the dew point temperature of the air inside the cargo at Bombay was 25°C. Now, July is a mid-winter month in the southern hemisphere. Consequently, after the ship crosses the equator and approaches Australia, the temperature of the outside air as well as of the surrounding sea water progressively decreases and the ship's boards become correspondingly colder by thermal conduction. When the temperature of the board side falls below 25°C, the original dew point of the air in the ship's hold, the air in contact with the board-side inside the ship's hold, cannot retain the same amount of water-vapour as it did when the ship was in Bombay. Consequently, the excess of water-vapour condenses on the board-side (and on decks or ceilings) and the cargo may get wet either by direct contact or by the water dropping down. The water, which thus wets the cargo and enters into it, is referred to by seamen as 'sweating' of the cargo.

Sweat on cargo can also be caused by moisture arising from the cargo itself as in the case of fruits, vegetables, etc. Also some types of cargo such as jute, wood, cotton and hides are 'hygroscopic'; they have an affinity for moisture which is so great that they can absorb moisture even from air whose relative humidity is not very high. Such materials also sweat inside the ship's hold.

Sweating of cargo can also be caused by faulty ventilation procedures. For instance, certain types of cargo emit foul smell or exude poisonous vapours. In order to get rid of these odours and gases, seamen have necessarily to employ ventilation (Thomas, 1961). They usually admit fresh clean air from the outside atmosphere and allow the foul air inside the cargo space to escape through the discharge vents. Now if the *dry bulb temperature* of the air inside the cargo space is initially say 15°C, and the air from the outside atmosphere admitted by ventilation has a *dew point* of 20°C, the admitted air cannot retain all the water vapour it held initially and at least some of the water vapour will be precipitated as sweat on the cargo.

Seamen are also aware of another type of danger to cargo, namely, that due to heat internally generated within certain types of cargo, *e.g.*, coal, hay and wool if wet or damp (Thomas, 1961). The heat generated in such cases, if left unchecked, may lead to spontaneous combustion and outbreak of fire, resulting in the loss of the ship, not to mention the loss of the cargo. For removing the heat generated, seamen have to employ ventilation. But this very ventilation can cause sweat-hazards if it is inappropriately employed in a meteorological situation of the type explained in the preceding paragraph.

Basic Infrared Spectroscopy. By J. H. Van der Maas. (Heyden & Son Ltd., Spectrum House, Alderton Crescent, London N.W. 4), 1969. Pp. 108. Price £ 1.10.0 ; $ 3.50 ; DM 13.50.

Infrared spectroscopy has become an indispensable tool in organic chemistry. In its application, especially to macromolecules, practice has far outrun theory. Interpretation of the spectra of large molecules involves theoretical methods which are often different from those applicable to small molecules. The booklet provides a reasoned approach to this aspect of the subject and will act as a guide to those starting infrared spectroscopy. Besides, the appendices on typical band contours, correlation charts, and infrared absorption frequencies of functional groups will be of ready help to graduate workers. A. S. G.

Physician's Book Compendium. Editor : Max Celnick. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1970. Pp. 846. Price $ 29.50.

This *Compendium* is an indispensable reference volume to physicians who would like to keep abreast of times in the rapidly expanding field of medical knowledge and medical information. It is a comprehensive guide to medical books in print. More than 10,000 books now in print are listed and they include besides medical texts, books on topics of general interest to the medical profession, such as doctor-patient relations, forensic medicine, nutrition, exercise, and so on.

The basic divisions of the *Compendium* are by medical specialty. Within each specialty, there are sub-specialties under each of which are listed the books giving the author publisher and in many cases, a brief description of the contents.

Supplements to this 1970 *Compendium* will be issued periodically to include new publications. A. S. G.

ANNOUNCEMENTS

First International Mycological Congress

Arrangements are being made to hold the First International Mycological Congress from 7 to 16 September 1971 at Exeter, Devon, where accommodation will be available in the University Halls of Residence.

The main feature of the programme will be a series of broadly based symposia with invited speakers. These will be grouped into seven sections: Structure and Morphogenesis, Cytology and Genetics, Taxonomy, Physiology and Biochemistry, Industrial and Applied Mycology, Ecology, Symbiosis and Pathogenicity. In addition there will be many less formal meetings and ample opportunities for the exchange of ideas.

Further details may be obtained from Professor J. Webster, Secretary, First International Mycological Congress, University of Exeter, Exeter, Devon, England.

ERRATUM

Curr. Sci., 1969, 38, 510, Line 1 :
For "*m*-Menth"
read "*m*-Mentha"

Curr. Sci., 1970, 39 :

(1) Page 220, Column 1, Line 27 from top
Instead of Little Rann of Kutch off Kharagodha *Read* 10′ N., Long. 71° 39′ E.), District Kutch.

(2) Page 221, Column 2, Line 1
Instead of 34 *Read* 32.

(3) Page 222, References
2. Singh, G., *Indian Geohydrology*, 1967, 3 (1), 111.

Books Received

The Geological Society of America

Memoir No. 116—Studies in Volcanology—A Memoir in Honor of Howel Williams. Edited by R. R. Coats, R. L. Hay and C. A. Anderson. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. 678. Price $ 19.25.

Memoir No. 117—Bibliography of Fossil Vertebrates. Edited by C. L. Camp, H. J. Allison, R. H. Nichols and H. McGinnis, 1968. Pp. xlii + 644. Price $ 14.54.

Special Paper 98 : A Catalog of Analyzed Calciferous and Subcalciferous Amphiboles together with their Nomenclature and Associated Minerals. By Bernard E. Leak, 1968. Pp. vi + 195. Price $ 7.50.

Special Paper 99 : Tectonic, Plutonic and Metamorphic History of the Central Kootenary Arc British Columbia, Canada, 1968. Pp. 94. Price $ 6.00.

Special Paper 112 : Pleistocene Recent Stratigraphy Evolution and Development of the Apalachicola, Coast, Florida. By J. E. Schnable and H. Grant Goodell, 1968. Pp. viii + 72. Price $ 2.75.

2048-70. Published by S. R. S. Sastry, Current Science Association, Bangalore-6,
and Printed by M. S. Narayanamurthy at The Bangalore Press, Bangalore-18.

DEW POINT TEMPERATURES OVER THE WORLD AND THEIR IMPORTANCE TO INDIAN SHIPPING

C. RAMASWAMY

C/o The Observatory, Lodi Road, New Delhi-3

ABSTRACT

It is pointed out that dew point temperature measurements are very important for the efficient management of cargo ventilation in Indian ships and for the prevention of sweat-damage to cargo when the ships undertake long voyages around the world.

Maps of Monthly Mean Dew point temperatures at sea-level over the globe between 75° N. and 65° S. in January, April, July and October are presented and discussed with reference to the Indian Shipping routes.

INTRODUCTION

THERE are a number of ways of defining the humid state of the atmosphere and the term "Dew point" is one of the ways of defining it. For the purpose of this article, the dew point may be defined as the temperature at which the moisture present in any sample of air is just sufficient to saturate it. If the sample of air is cooled *below* this critical temperature which is referred to as the dew point temperature or simply as the dew point, the air cannot hold all the water-vapour which was initially in it and consequently, the excess of water-vapour will condense into droplets of water.

To illustrate the significance of the dew point in cargo-ventilation problems, let us give an example. Suppose, in the month of July, a certain type of cargo is stowed into a hold in a ship in Bombay which is to proceed to Fremantle in South Australia and that it is *not* subject to ventilation during the voyage. Also suppose that the dew point temperature of the air inside the cargo at Bombay was 25° C. Now, July is a mid-winter month in the southern hemisphere. Consequently, after the ship crosses the equator and approaches Australia, the temperature of the outside air as well as of the surrounding sea-water progressively decreases and the ship's boards become correspondingly colder by thermal conduction. When the temperature of the board-side falls below 25° C.—the original dew point of the air in the ship's hold—the air in contact with the board-side inside the ship's hold, cannot retain the same amount of water-vapour as it did when the ship was in Bombay. Consequently, the excess of water-vapour condenses on the board-side (and on decks or ceilings) and the cargo may get wet either by direct contact or by the water dropping down. The water, which thus wets the cargo and enters into it, is referred to by seamen as "sweating" of the cargo.

Sweat on cargo can also be caused by moisture arising from the cargo itself as in the case of fruits, vegetables, etc. Also some types of cargo such as jute, wool, cotton and hides are "hygroscopic": they have an affinity for moisture which is so great that they can absorb moisture even from air whose relative humidity is not very high. Such materials also sweat inside the ship's hold.

Sweating of cargo can also be caused by faulty ventilation procedures. For instance, certain types of cargo emit foul smell or exude poisonous vapours. In order to get rid of these odours and gases, seamen have necessarily to employ ventilation (Thomas, 1961). They usually admit fresh clean air from the outside atmosphere and allow the foul air inside the cargo space to escape through the discharge-vents. Now if the *dry bulb temperature* of the air inside the cargo space is initially say 15° C. and the air from the outside atmosphere admitted by ventilation has a *dew point* of 20° C., the admitted air cannot retain all the water-vapour it held initially and at least some of the water-vapour will be precipitated as sweat on the cargo.

Seamen are also aware of another type of danger to cargo, namely, that due to heat internally generated within certain types of cargo, *e.g.*, coal, hay and wool if wet or damp (Thomas, 1961). The heat generated in such cases, if left unchecked, may lead to spontaneous combustion and outbreak of fire, resulting in the loss of the ship, not to mention the loss of the cargo. For removing the heat generated, seamen have to employ ventilation. But this very ventilation can cause sweat-hazards if it is inappropriately employed in a meteorological situation of the type explained in the preceding paragraph, The above instances are intended mainly to show that open ventilation, *which is primarily employed to reduce moisture in the holds,* has to take into account various aspects. Above all, it requires a correct scientific appreciation of the various factors involved.

Past experience has shown that cargo-damages due to sweat can be very considerable (Thomas, 1961) and can lead to very heavy claims. In the case of countries like India, such heavy claims are bound to have an impact on national economy.

It is relevant to mention in this connection that a survey conducted by the World Meteorological Organisation (1957) of such open ventilation-procedures has shown that, in the vast majority of cases, ships' officers, belonging even to the scientifically-advanced countries of the West, followed only certain thumb-rules and that they had no clear logical instructions in this regard. On the basis of this survey, the WMO (1957, 1968) stressed the desirability of a proper scientific appreciation of the problem and suggested ventilation procedures on the basis of regular but simple measurements of the important meteorological element, the dew point temperature. The purpose of this article is to focus the attention of Indian shipping interests to this problem and to provide new scientific material in the form of mean dew point charts for the world which will lead to a better appreciation of the scientific aspects of the problem.

Scientific Principles and Procedures for Ventilation Management

The fundamental point we have to remember when discussing ventilation management is that the cargo is a big reservoir of heat and moisture and that it tends to maintain in ships' holds, the meteorological conditions at the loading ports and/or the conditions within the cargo itself. We should also bear in mind that the temperature of the cargo will change more slowly than the ship's environment along its course.

From the definition of the dew point given earlier, it may be seen that the dew point is the most suitable meteorological element for the purpose we have in view. Hence, measurements of dew point temperature within the ship's holds would give us the best possible indication of the moisture content of the air above and within the cargo. Unfortunately, however, measurement of the dew point temperature in the interstices in the cargo is a very complex problem and it is doubtful whether representative values of the dew point can be obtained even with a number of very expensive distant-reading devices. On the other hand, it is reasonable to assume that when fresh air from the atmosphere outside the ship is admitted into the air spaces, the dew point of the outflowing air will be a good indicator of the general moisture conditions of the hold from which it comes. Hence, whatever may be the arrangement for reducing the moisture in holds, *its practical management should as far as possible be guided by the measurement of the dew point temperature.* This can be done with the help of a simple hand-driven fan-ventilated psychrometer suggested by WMO (1957, 1968). The procedure to be followed will be on the following lines:

(*i*) Measure the dew point of the outside air that will flow into the ventilators. Keep an eye on the difference between the dry bulb and the dew point temperatures. If the difference between the two, *i.e.,* if the "dew point depression" is small, you run the risk of introducing air which may cause sweat on the cargo even if the dry bulb temperature is low.

(*ii*) Put the ventilation system into operation.

(*iii*) Shortly after ventilation is started, measure the *dew point* of the air flowing *out from* the ventilator.

(*iv*) Continue ventilation as long as the outflowing air has a *higher dew point* than that of the air stream from the outer atmosphere which feeds into the ventilator.

(*v*) If, by chance, the exit stream shows a *lower dew point in comparison with the input air, stop ventilation forthwith,* as otherwise, moisture will be deposited in the hold and further ventilation will only increase sweat-hazards.

(*vi*) At longer intervals, but, at less than 6 hours, recheck the dew point of the atmosphere around the ship that feeds into the ventilation system. Use this latest reading as a fresh starting-point for determining whether ventilation is necessary or not.

(*vii*) On the basis of the readings recorded, maintain graphs showing the dry bulb and dew point temperatures at the inflow and outflow ends and enter on the graphs the times of opening and stopping of the ventilation system.

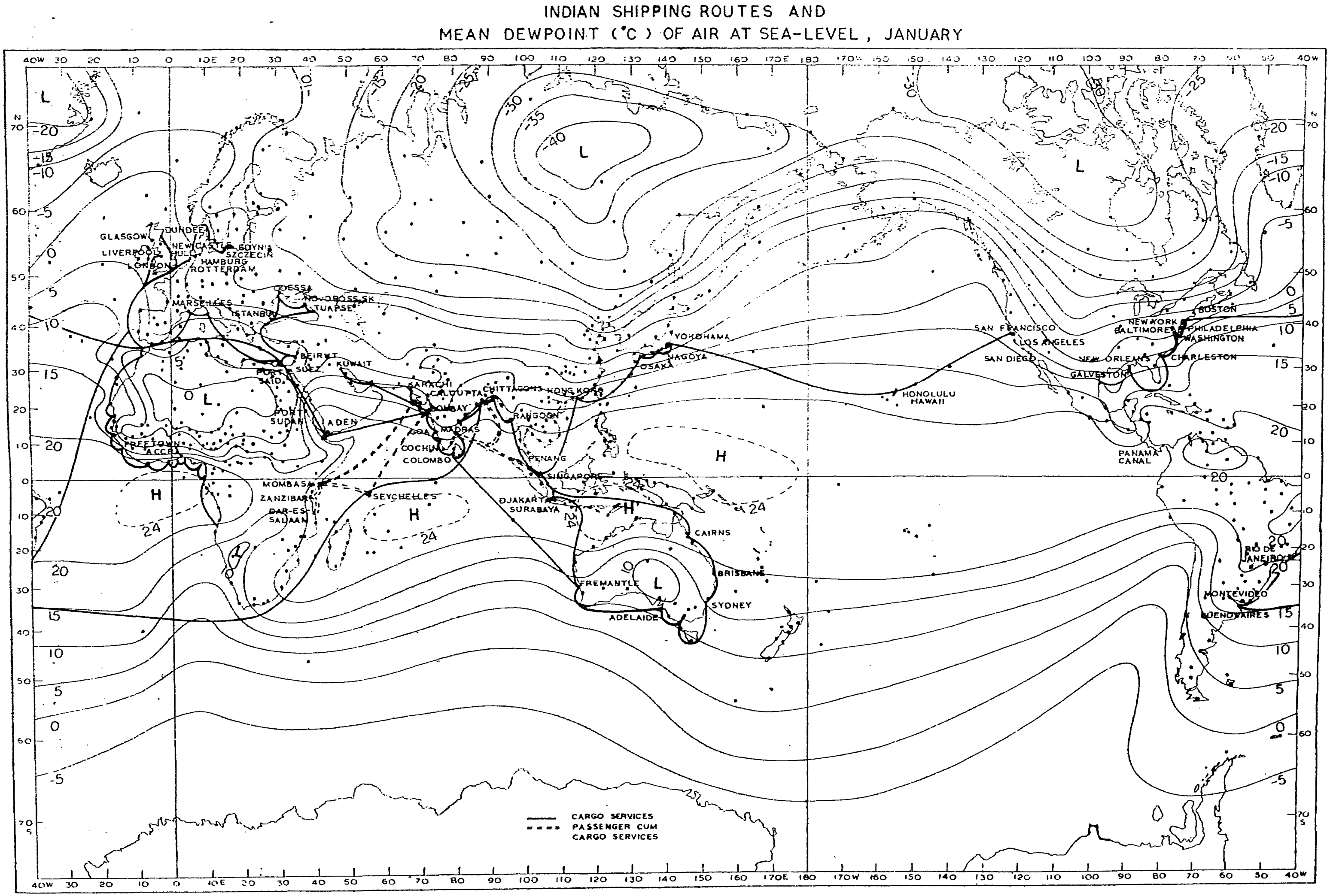


FIG. 1. The thin continuous lines are lines of equal dew point—the "isodews"—at sea-level. They have been drawn at intervals of 5° C. The broken thin lines are odd isopleths of 24° C. The shaded circles show the observatories on the basis of whose long-term mean data, the mean isodews have been drawn. Stations whose altitudes were *more than 800 geopotential metres* above sea-level have been *omitted* so that the maps may be truly representative of near-sea-level conditions. For analysis over North Atlantic and North Pacific Oceans, refer to text. (*Contd. under Fig.* 2.)

IMPACT ON NATION'S ECONOMY

Table I* gives an idea of the annual export of certain principal commodities from India which are liable to sweat-damage. Table II* gives similar information in respect of annual imports of principal commodities into India. The values of the commodities in lakhs of rupees may be particularly noted. These will give an idea of the possible losses if the cargo is damaged by sweat due to unscientific management of ventilation.

TABLE I

Exports† from India during 1968–69

Serial No.	Commodity	Value in lakh Rs.	Percentage to total exports
1	Jute and jute manufactures	21,694	16·0
2	Solvent extracted groundnut oil cake	4,947	3·7
3	Leather, all kinds	7,199	5·3
4	Tobacco and tobacco manufactures	3,316	2·5
5	Spices	1,541	1·1
6	Cotton (raw)	1,574	1·2
7	Hides and skins	532	0·4
	TOTAL	40,803	30·2

TABLE II

Imports† into India during 1968–69

Serial No.	Commodity	Value in lakh Rs.	Percentage to total imports
1	Food grains:		
	Wheat	25,949	
	Rice	5,747	
	Other cereals	1,501	
		33,197	17·8
2	Chemicals:		
	Fertilisers	15,019	
	Others	22.407	
		37,426	20·1
3	Cotton	9,018	4·8
4	Fruits and vegetables	10,952	5·9
	TOTAL	90,593	48·6

ISODEWS OVER THE WORLD

The dew point temperatures along a ship's route do not vary at random. They follow, *in the mean*, a definite pattern, changing gradually with the change in the months of the year.

Figures 1 and 2 show the *mean* dew point temperature maps for the world at sea-level prepared on the basis of recent data for a large number of years (*e.g.*, from WMO, 1962). For the North Atlantic and North Pacific Oceans, isopleths of dew points based on ships' logs, "ocean stations" and selected coastal stations as published by U.S. Weather Bureau and Navy Hydrographic Office (1961, Navair, 1966) were taken into account. As far as the author is aware, previous *global* dew point maps of this kind were published by Sir Napier Shaw more than three decades ago (Shaw, 1936) but they were based on far scantier data than the present maps.

Over the isopleths of dew points which we shall refer to as ISODEWS, we have superposed a map showing the routes along which Indian ships were plying in 1967 (Central Committee for National Maritime Day Celebrations, Bombay, 1967).

Although the isodews are based on monthly mean values, they strikingly bring out the large range of dew points, through which an Indian ship has to pass during some of its voyages. For instance, a ship proceeding from Colombo to Fremantle and Adelaide during the South-west monsoon month of July passes from a region of 25° C. to a region of about 5° C., in the mean, in dew point. Likewise, a ship proceeding from Bombay to Buenos Aires *via* Seychelles and round the Cape of Good Hope especially in the month of January will pass through steep dew point gradients at several stages after passing the Mozambique Channel. It is along such routes that great care will have to be exercised in ventilation management.

Similar mean world maps for the transition months of April and October have also been prepared but they are not reproduced here. However, Table III which gives the monthly mean dew points at selected stations will give an idea of the mean dew point variations in the transition months.

It is important to remember that the above-mentioned maps represent the mean conditions

---

* These figures have been extracted from the *Merchant Marine Directory Supplement*. 1970 published under the authority of Director-General of Shipping, Government of India, by the Central Committee for National Maritime Day Celebrations, Bombay.

† The lists of commodities vulnerable to sweat-hazard, given above, are by no means exhaustive.

INDIAN SHIPPING ROUTES AND
MEAN DEWPOINT (°C) OF AIR AT SEA-LEVEL, JULY

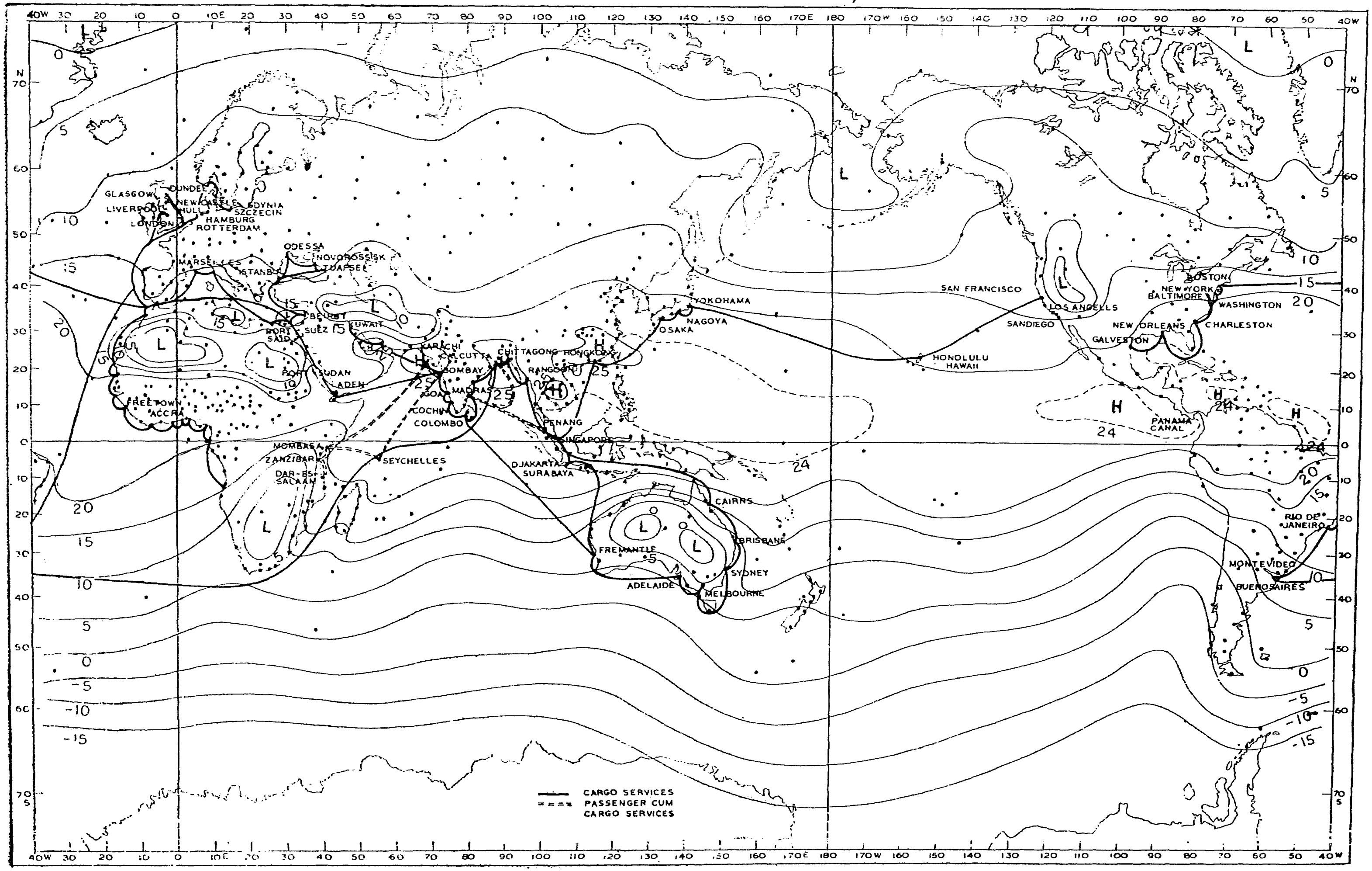


FIG. 2. The thick lines are the Indian shipping routes as in March 1967. There are now additional routes extending to Great Lakes in U.S.A. and to Mauritius. Note that the gradients of the isodews in the southern hemisphere are steeper than those in the northern hemisphere over the vast oceans equatorward of 60° N and 60° S. Areas where the gradients of the isodews are steep are those where special watch should be kept over the dew point temperatures if the cargoes are ventilated by open ventilation techniques.

TABLE III

Monthly mean dew point temperatures

S. No.	Name of station		Country	Monthly mean dew point in °C.			
				January	April	July	October
1	Bombay	..	India	18	22	25	24
2	Colombo	..	Ceylon	21	24	24	23
3	Honkong	..	Honkong	11	19	25	19
4	Tokyo	..	Japan	− 4	7	21	13
5	Hawaii	..	U.S.A.	17	18	19	19
6	San Francisco	..	U.S.A.	6	8	11	10
7	London	..	U.K.	2	5	13	8
8	Accra	..	Ghana	23	24	22	23
9	New York City	..	U.S.A.	− 4	4	17	9
10	Montevideo	..	Uruguay	16	13	7	10
11	Cape Town (D. F. Malan)		Republic of South Africa	14	12	9	10
12	Mahe (Seychelles)		Seychelles	23	24	21	23
13	Perth (Fremantle)	..	Australia	13	11	8	9
14	Adelaide	..	Australia	10	9	6	7

in the respective months. Although they will be useful in long-term planning of ventilation-management for new shipping routes, the actual dew point temperatures, on individual occasions, may differ appreciably from the mean values. For example, on certain occasions, especially in middle latitudes, there could be sudden outbreaks of cold air from polar regions in either of the hemispheres. Cargoes on the 'tween decks (Thomas, 1961, WMO, 1957, 1968) would be affected by such invasions of cold air. Foreknowledge of this event will help the Indian shipping officers to plan for ventilation measures before the actual encounter with the chilling condition.

CONCLUSION

The general principles and procedures explained above and the mean isodew maps for the world will give the Indian shipping interests an idea of the importance of the dew point as a parameter over which the ships' officers will have to keep watch during their long voyages around the world. By so doing, they might be making a significant contribution to the betterment of our national economy.

ACKNOWLEDGEMENTS

The mean isodew maps for the world were prepared with the financial support of the Council of Scientific and Industrial Research, New Delhi, as part of a Research Scheme. The author's warm and sincere thanks are due to Mr. S. N. Banerji, Senior Chartering Officer, Ministry of Transport, Government of India, for making available relevant literature about stowage of cargoes and for providing information about the Indian shipping routes. Mr. P. S. Harihara Iyer, Meteorologist, New Delhi, went through the manuscript of this article and offered his comments for which the author is grateful. The author is also indebted to Dr. P. Koteswaram, Director-General of Observatories, for providing facilities for this investigation.

---

1. Central Committee for National Maritime Day Celebrations, Bombay, *Merchant Marine Directory*, 1967.
2. —, *Ibid.*, Supplement, 1970.
3. Navair, U. S. A., *50-IC-52*, 1966.
4. Shaw, Napier, *Manual of Meteorology*, Camb. Univ. Press, 1936, 2, 130.
5. Thomas, R. E., Captain, *Stowage, The Properties and Stowage of Cargoes*, Glasgow Brown Son and Ferguson Ltd., 1961, pp. 8, 15, 21, 22, 30, 71 to 390.
6. U.S. Weather Bureau and U.S. Navy Hydrographic Office. *Climatological and Oceanographic Atlas for Mariners*, 1961, 1 & 2.
7. World Meteorological Organisation (WMO). *Notes on the Problem of Cargo Ventilation*, by W. F. Macdonald, Technical Note No. 17, 1957, Reprinted 1968.
8. —, *Climatological Normals (CLINO) for Climat and Climat Ship Stations for the Period* 1931–1960, 1962.

ON THE SECRETORY ACTIVITY OF THE CELLS OF THE HEPATIC CAECA IN THE INSTARS AND ADULTS OF SOME ACRIDIDS (ORTHOPTERA : INSECTA)

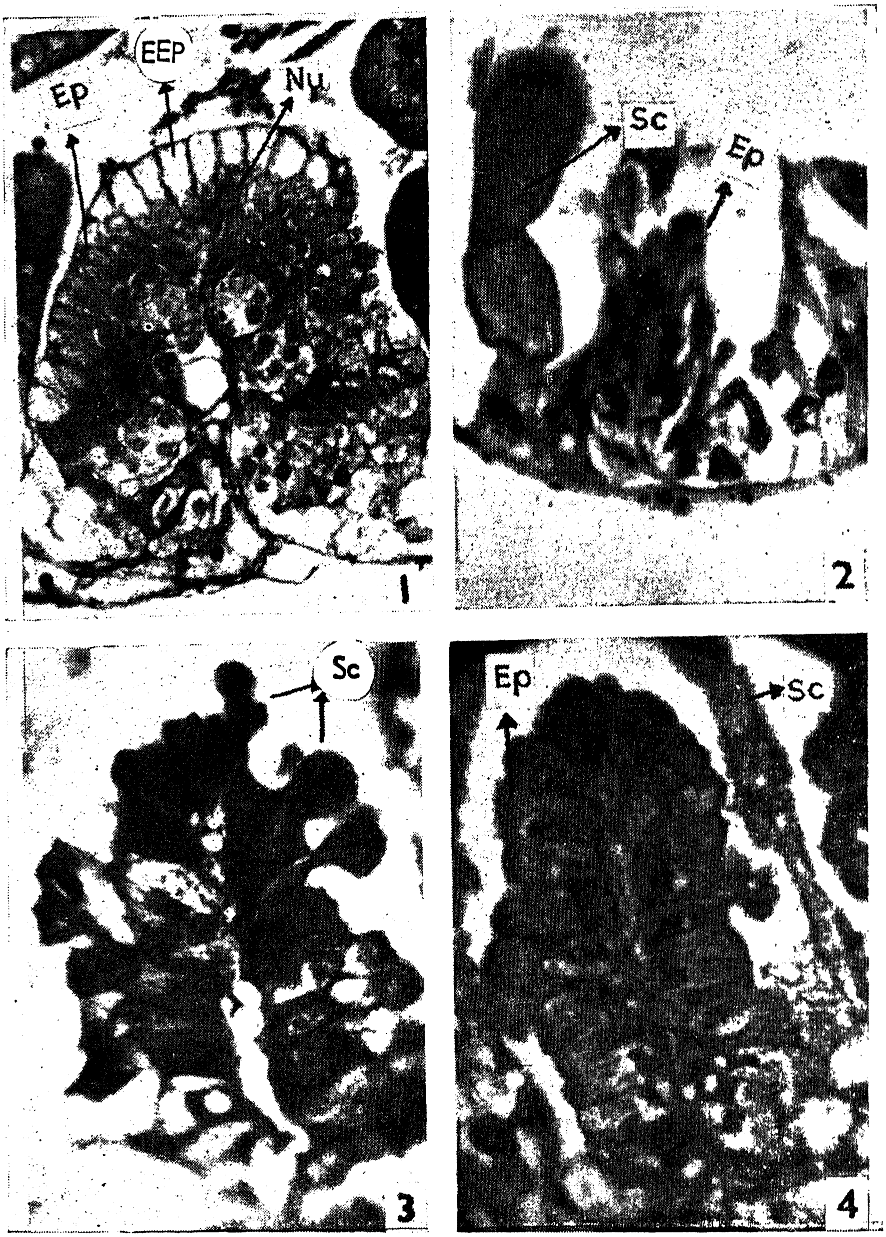
M. C. MURALIRANGAN AND T. N. ANANTHAKRISHNAN
Entomology Research Unit, Loyola College, Madras-34

INFORMATION on the secretory activity of the cells of the hepatic cæca and the midgut epithelium in Acridids is restricted to the works of Hodge,[1] Khan,[2,3] Shinoda[4] and Woodruff.[7] In general the secretions are regarded as merocrine, the secretory cells not breaking in the process and the nucleus remaining intact. Shinoda[4] however observes that the secretions are normally merocrine, becoming holocrine when fed after a period of fasting. Observations of Srivastava[5] in *Periplaneta americana* fed after a month's starvation, show the secretions to be of merocrine type. Srivatsava[6] working on *Liogryllus bimaculatus* Sauss. also reports that the midgut cell extrusions are caused by cell degeneration and do not represent the digestive secretions. Hodge[1] confirms the holocrine nature of secretion in *Melanoplus* at the time of intensive digestive activity and merocrine when not particularly active. Observations pertaining to the nature of the secretions in the nymphs and adults of *Eyprepocnemis alacris alacris* (Serv.) as well as in the adults of *Truxalis indicus* Bol. and *Pœkilocerus pictus* Fabr. are presented here.

For staining purposes Haidenhain's hæmatoxylin and Haidenhain's Azan with 3% alum as mordent was used. Better results were obtained when 1½% alum was first used and subsequently 3% differentiator.

Observations on the adults of all the three species mentioned showed typically holocrine mode of secretion in normally active individuals of *E. alacris alacris* and apocrine in *Truxalis indicus* and *Pœkilocerus pictus* (Figs. 1, 3 and 4). While the major portion of the secretory material in *E. alacris alacris* is extruded into the lumen of the lobe of the hepatic cæca and pouring out through the interspaces between different lobes, a limited amount appears to be directly extruded through the brush border of the cells. In the newly formed folds of the cæca, the cells are long and there is no lumen or cavity in the folds. During the secretory activity, the secretion is poured into the lumen, resulting in its enlargement. Sometimes the folds break at some points, thus releasing the secretion into the lumen of the cæca. In *Truxalis indicus* and *Pœkilocerus pictus* the distinct bladders or vesicles project into the lumen of the hepatic cæca and these could be explained in terms of foldings to form complex crypts of cell outgrowth, discharging the secretory products. In *Truxalis indicus* the secretory vesicles are more numerous at the apex, while in *Pœkilocerus pictus* they are more basally situated. When the insects (*E. alacris alacris*) were fed for 1½ days after moulting into the adult and starved for 3½ days, the epithelial cells appear distorted and the folds or the villi become completely disorganised, followed by nuclear clumping towards the muscular layer, without any secretory granules being present in the cytoplasm of the cells.

Examination of the structure of the hepatic cæca in the nymphal instars of *E. alacris alacris* (Fig. 2) reveals that the nature of the release of secretion was found to vary among the instars of the same species. In the first three instars the secretions are of merocrine type while in the IV and V instars both holocrine and merocrine were found to be present. In the IV instar more of merocrine nature was observed, while in the V instar it was *vice versa*. Even among the adults of the same species more of holocrine nature was observed. In the I nymphal instar, immediately after hatching the epithelial cells are single layered, with 6 cæcal lobes and the secretion is of merocrine type. In the same instar, two days after hatching, the epithelial cells become columnar and broad. With the increase in the number of cells in the II instar, there is a reduction in the nuclear size upto IV instar and it enlarges once again in the V instar and in the adult condition. There is a tendency for the nuclei to move towards the anterior end from the base, during the secretory activity depending upon the activity of the cells. During the secretory activity, the secretory material appears to be extruded through the brush border in merocrine secretions, many vacuoles appearing in the process. When the cells are loaded with secretory material, no vacuoles seem to be present. Among the cæcal folds, some are long while others are short, the long ones being loaded with secretory material and designated as major folds, while the neighbouring smaller folds, not containing much of the secretory material, as minor folds. Presumably, the major folds when full of secretion, break up, liberating the secretory products. During this period the minor folds



FIGS. 1–4. Fig. 1. Adult hepatic cæcal lobe of *Eyprepocnemis alacris alacris.* Fig. 2. Showing the release of secretion in II instar of *Eyprepocnemis alacris alacris.* Fig. 3. Adult hepatic cæcal lobe of *Truxalis indicus.* Fig. 4. Adult hepatic cæcal lobe of *Pœkilocerus pictus.* (*Ep.*—Epithelial cell; *Nu.*—Nucleus; *EEP*—Emptied epithelial cells; *Sc.*—Secretions.)

become active and may develop to form the major ones, and thus alternate with each other in relation to the secretory activity of the cæcal lobes. The cells in the posterior region of the hepatic cæca do not take part in the secretory activity but they may help in storing the secretory products produced in the anterior lobe of the cæca.

---

1. Hodge, C., *J. Morph.*, 1937, **59**, 423.
2. Khan, M. A., *Curr. Sci.*, 1963, **32**, 169.
3. —, *Indian J. Ent.*, 1963 *a*, **25**, 200.
4. Shinoda, O., *Zellforsch Mtky Anat.*, 1927, **5**, 278.
5. Srivastava, R. P., *Curr. Sci.*, 1955, **24**, 57.
6. —, *Experientia*, 1966, **22** (6), 372.
7. Woodruff, *J. Morph.*, 1933, **55**, 53.

LETTERS TO THE EDITOR

ULTRASONIC VELOCITY IN α-PICOLINE-WATER MIXTURE

ULTRASONIC velocity and its temperature variation in mixtures of organic liquids with water were studied by many investigators.[1] The velocity variation with concentration is non-linear, showing a peak in the velocity curve at a particular concentration. Temperature variation of velocity of the mixture for different concentrations showed shifting of the velocity peak to lower concentrations with increase of temperature. In all the liquids hitherto studied, except in water, the velocity falls as the temperature is increased, whereas in water the velocity increases with temperature upto about 74° C., after which it decreases. So it is natural to expect that a mixture can be found in which velocity is not dependent on temperature at any rate, over a limited temperature range. So far only two such liquid-mixtures were reported. One is ethyl alcohol-water mixture reported by Giacomini,[2] consisting of 17·35% by weight of alcohol, giving a temperature independent of velocity of 1,611 m/s, in the temperature range 5° C. to 45° C. and the other is morpholine-water mixture reported by the authors,[3] consisting of 15·5% by weight of morpholine, giving a temperature independent of velocity of 1,565 m/s, in the temperature range 20° C. to 60° C. This result has a useful feature for time delays.

In this communication, is reported the temperature variation of ultrasonic velocity in α-picoline-water mixture. The velocity at room temperature and the temperature variation of velocity of the mixture at different concentrations were determined by the methods developed in our laboratory.[4,5] The results are presented in Fig. 1, which shows that, at a particular temperature, the velocity variation with concentration is non-linear showing a peak at a particular concentration. The concentration corresponding to the peak velocity decreases with increase of temperature. It can be seen that the velocity of the mixture consisting of 24·8% by weight of α-piroline is 1,546 ± 2 m/s remaining constant between 5° C. and 35° C.

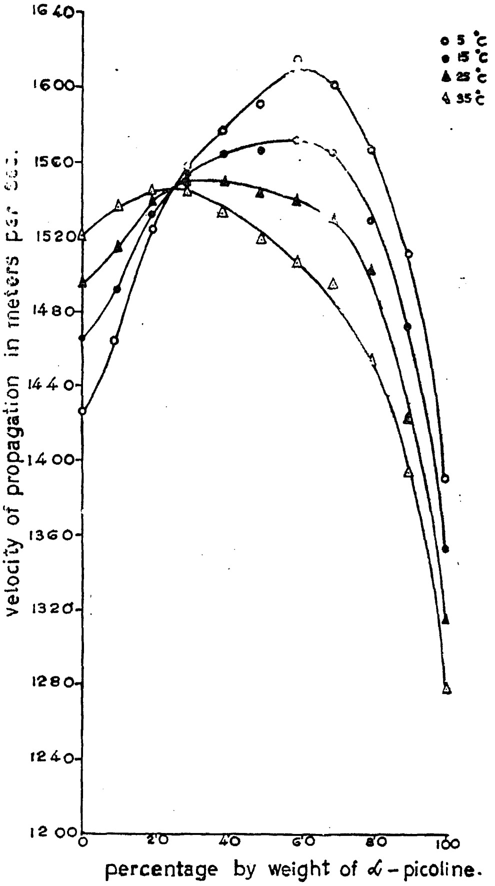


FIG. 1. Ultrasonic velocity in a mixture of α-picoline and water at various temperatures and various concentrations.

The authors acknowledge with thanks the financial assistance of the Council of Scientific and Industrial Research.

Ultrasonic Lab., K. MALLIKHARJUNA SWAMY.
Andhra University, P. SITARAMASWAMY.
Waltair (India), *January* 7, 1970.

---

1. Vigoureux, *Ultrasonics*, Chapman & Hall Limited, London.
2. Giacomini, A., *Acta Pont. Acad. Sci.*, 1942, **6**, 87.
3. Swamy, K. M. and Swamy, P. S., *J. Phys. Soc. (Japan)* (accepted for publication), **28**, 1.
4. Rao, K. S. and Rao, B. K., *J. Sci. and Ind. Res.*, 1957, **16 B**, 483.
5. — and —, *Jour. Acous. Soc. Amer.*, 1959, **31**, 439.

A NOTE ON THE GREEN BANDS OF THE CaF MOLECULE

ROTATIONAL analyses of the band spectra of diatomic alkaline earth fluorides excepting BeF and BaF have not been carried out so far because of the small separation between the bands in a sequence. The green (B–X) system of CaF lying between 5291 and 5152 Å consists of sequences of double-headed red degraded bands and is assigned to a $^2\Sigma$–$^2\Sigma$ transition. The doubling of the heads has been suggested by Harvey[1] to be due to large spin splitting of the upper $^2\Sigma$ state.

Rotational constants for only the two lowest vibrational levels ($v' = 0$ and $v'' = 0$) were reported earlier,[2] because the rotational lines of the other bands were overlaid by the neighbouring ones.

We report the rotational constants of the B and X states of the CaF molecule upto the 14th vibrational level.

The mode of excitation of this band system from a pure sample of calcium fluoride is described in an earlier paper.[2] The bands of the $\Delta v = 0$ and $\Delta v + 1$ sequences are photographed in the first order of the 35 foot grating spectrograph at B.H.U. with a dispersion of 0·66 Å/mm. The R_1–R_2 heads for both the sequences are well resolved (Fig. 1). The Bv' and Bv'' values for the different vibrational levels were calculated from the R_1–R_2 head separation ($\Delta\nu$RH12) of the bands of the $\Delta v = 0$ and $\Delta v = +1$ sequences with the help of the relation :

$$\Delta\nu\text{RH12} = \frac{\gamma' Bv''}{Bv' - Bv''}$$

where γ' = spin splitting constant for the upper state, Bv' and Bv'' are the rotational constants of the upper and lower states respectively. The lower state spin splitting constant has been known[2] to be negligibly small and $\gamma' = 0 \cdot 067$ cm.$^{-1}$ Table I contains the Bv values for the upper and lower states of this system. The observed $\alpha e'$ and $\alpha e''$ values compare very well with those calculated from Pekeris[3] relation ($\alpha e' = 0 \cdot 0024$ cm.$^{-1}$ and $\alpha e'' = 0 \cdot 0028$ cm.$^{-1}$).

TABLE I

Bv′ and Bv″ values for the $B^2\Sigma$–$X^2\Sigma$ system of CaF

V	Bv′ (cm.$^{-1}$)	Bv″ (cm.$^{-1}$)	V	Bv′ (cm.$^{-1}$)	Bv″ (cm.$^{-1}$)
0	0·3474	0·3510	8	0·3249	0·3295
1	0·3448	0·3484	9	0·3220	0·3273
2	0·3411	0·3449	10	0·3199	0·3242
3	0·3384	0·3422	11	0·3164	0·3219
4	0·3354	0·3396	12	0·3131	0·3183
5	0·3333	0·3376	13	0·3103	0·3153
6	0·3309	0·3351	14	0·3079	0·3132
7	0·3280	0·3325			

$Be' = 0 \cdot 3489$ cm.$^{-1}$, $Be'' = 0 \cdot 3524$ cm.$^{-1}$, $\gamma e' = 1 \cdot 937$ Å.U., $\gamma e'' = 1 \cdot 927$ Å U. $\alpha e' = 0 \cdot 0028$ cm.$^{-1}$, $\alpha e'' = 0 \cdot 0027$ cm.$^{-1}$.

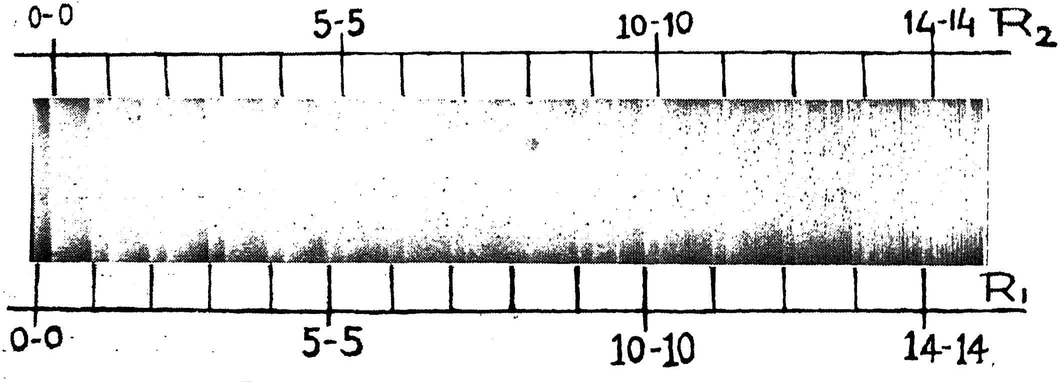


FIG. 1. $\Delta v = 0$ sequence ot the $B^2\Sigma - X^2\Sigma$ system of CaF.

The authors are thankful to Dr. H. Misra, Professor and Head of the Department of Physics, Ravenshaw College, Cuttack-3, for his encouragement in carrying out this work.

Department of Physics, Ravenshaw College, Cuttack-3, January 19, 1970.
D. P. NANDA.
B. S. MOHANTY.

---

1. Harvey, A., *Proc. R. Soc.*, 1931, **133 A**, 336.
2. Mohanty, B. S. and Upadhya, K. N., *Ind. J. Pure and Applied Phys.*, 1967, **5** (11), 523.
3. Pekeris, C. L., *Phys. Rev.*, 1934, **45**, 98.

ELECTRICAL PROPERTIES OF THIN SILVER FILMS

MEASUREMENTS on silver films were earlier reported by Chopra and Bahl[1] and Parikh and Naik.[2] In the Hall effect studies of the former workers the emphasis has been on Cu and Au films. The latter workers have concentrated on the evaluation of film thickness from the resistivity and Hall effect data. They find that their results show a deviation by about 30% from the measurements made with multiple beam interferometer technique. In view of this, an attempt has been made to study the conductivity and Hall effect in silver films and correlate with the size-effect theory[3-5] to fix up the parameters. This will, incidentally, help to assess the limits of accuracy to which the thickness of a film can be evaluated from the electrical measurements.

In the size-effect theory based on the free electron model, the electron transport phenomena, in metallic films, depend on the thickness of the film, for thicknesses of the order of electron mean free path. This analysis gives, for conductivity (σ) and Hall coefficient (R_H), theoretical expressions :

$$\left.\begin{aligned}\left(\frac{R_{H-F}}{R_{H-B}}\right) &= \frac{4}{3}\,K\,(\log K^{-1})^2\\ \left(\frac{\sigma_B}{\sigma_F}\right) &= \left(\frac{4}{3}\,K\log K^{-1}\right)\cdot\frac{(1-p)}{(1+p)}\end{aligned}\right\}\ \text{for the range, } K<1$$

and

$$\left.\begin{aligned}R_{H-F} &= R_{H-B}\\ \left(\frac{\sigma_B}{\sigma_F}\right) &= 1+\left[\frac{3\,(1-p)}{8K}\right]\end{aligned}\right\}\ \text{for the range, } K>1$$

where K is the ratio of the thickness of the film to the electron mean free path and *p* is the scattering coefficient. The subscripts 'F' and 'B' refer to film and bulk material respectively. Theoretically, therefore, σ_F and R_{H-F} can be evaluated assuming a definite scattering mechanism for the conduction electron at the surface of the film. In the present case, *p* is taken as zero assuming perfect 'diffuse' scattering.

Silver films were prepared by evaporation on well-cleaned glass substrates at room temperature in a vacuum system maintained at 10^{-5} mm. Hg, keeping the deposition rate constant. The thicknesses were determined by a multiple beam interferometer. The steady state resistance of the film was measured in vacuum and the Hall voltage after exposing to atmosphere, making use of standard potentiometer techniques. The conductivity and Hall coefficient were computed from these experimental values, knowing the dimensions of the film, the current passing through it and the applied magnetic field. In these measurements all precautions were taken and the data are reproducible to better than 5%. The results are plotted graphically in Fig. 1.

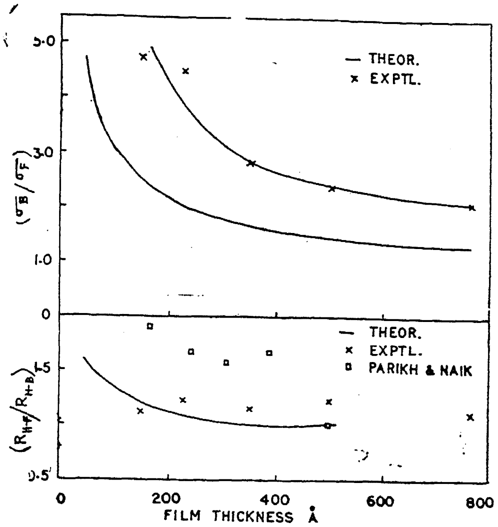


FIG. 1

To compare the results with the theory, curves for R_H and σ obtained from the above equations, are plotted. It is clear from Fig. 1, that there is a definite thickness dependence of σ and R_H, although there is no quantitative agreement with theory. This may be partly due to the simplified assumption that the scattering of the conduction electrons at the surface of the film is entirely 'diffuse'. By assuming part of the scattering to be 'specular', *i.e.*, $p > 0$, a closer agreement may probably be obtained. In addition, defect scattering especially at impurity centres may also be contributing since the silver sample used in the present studies is not of very high purity. As these measurements are made at room temperature, scattering due to thermal vibrations cannot be ruled out, in contributing to the resistivity of the film.

The Hall coefficient data of Parikh and Naik,[2] calculated from Table I of their paper, are also plotted for comparison. It can be seen that the present measurements show a better agreement with theoretical predictions in spite of all the limitations cited above.

Use of very high purity material in depositing thin films and their annealing are likely to improve the agreement quantitatively.

The authors are thankful to Prof. J. Bhimasenachar for his interest and encouragement. One of them (S. M.) is thankful to C.S.I.R. for awarding a Junior Research Fellowship.

Department of Physics, S. MOHAN.
S.V. University, P. JAYARAMA REDDY.
Tirupati, *January* 9, 1970.

---

1. Chopra, K. L. and Bahl, S. K., *J. Appl. Phys.*, 1967, **38**, 3607.
2. Parikh, D. O. and Naik, Y. G., *Indian J. Pure Appl. Phys.*, 1968, **6**, 437.
3. Fuchs, K., *Proc. Cambridge Phil. Soc.*, 1938, **34**, **100**.
4. Sondheimer, E. H., *Phys. Rev.*, 1950, **80**, 401.
5. —, *Advan. Phys.*, 1952, **1**, 1.

COMPLEXES OF URANYL ION WITH SOME AMINO AND MERCAPTO ACIDS

SYSTEMATIC aqueous pH titrations at 30° ± 0·1° C. and μ 0·1 M ($NaClO_4$) on systems of uranyl ion—cysteine; methionine; N-acetyl glycine and thiosalicylic acids have been carried out by us with a view to determine the composition(s) and stability constant(s) of complex(es) formed. The chemicals used were all of AnalaR grades. The pH meter (Universal Pye; cat. 10085) with a built-in calomel glass electrode was used and the recorded pH values were accurate to ± 0·02. Data of pH > 3·5 (hydrolysis) were not used in the calculations. Due to the low solubility of thiosalicylic acid in water, a 50% dioxan-water mixture was used for that system only. Dissociation constants of the ligand acids were determined by the conventional method[1] for amino-acids and by slope and intercept method due to Irving and Rossotti[2] for other acid ligands. Values of $\bar{n}$ and pL were calculated from the pH titration curves by the method adopted by Albert[3] for amino-acids and that by Irving and Rossotti[2] for other systems. Values of the stability constants of the metal complexes were evaluated from the slope and intercept[4] by least squares treatment (Table I and Fig. 1). The titrations were carried out over a twenty-fold variation in the total metal chelate concentration, in order to determine the presence of polymeric species.

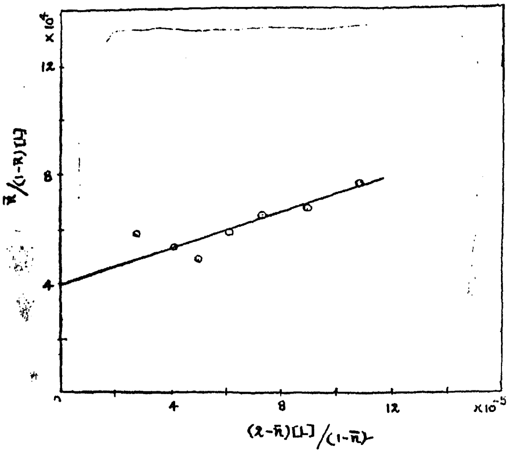


FIG. 1. Uranyl ion-thiosalicylic acid system.

$\mu = 0 \cdot 1$ M ($NaClO_4$) T = 30° ± 0·1° C

Plot of $\bar{n}/(1-\bar{n})$ [L] *versus* $(2-\bar{n})$ [L]/$(1-\bar{n})$

Slope = K_{ML_1} K_{ML_2}
= $3 \cdot 235 \times 10^8$
Intercept = K_{ML_1}
= $4 \cdot 000 \times 10^4$

We conclude from our results that:

(*i*) 1 : 1 complexes were formed with cysteine and N-acetyl glycine;

(*ii*) 1 : 1 and 1 : 2 complexes were formed with methionine and thiosalicylic acids;

(*iii*) absence of polymeric species of the chelates was indicated by the observed decreasing K_{ML} values with increasing total metal chelate concentration (5×10^{-4} M to 1×10^{-2} M);

(*iv*) both amino and carboxylic groups are involved in co-ordination to uranyl ion with further stabilization by S atom in the case of cysteine and without stabilization by S in the case of methionine as evidenced from the order of stability constants (Table);

TABLE I

Equilibrium constants of systems of uranyl ion with some amino and mercapto acids

$\mu = 0 \cdot 1$ M ($NaClO_4$) T = 30° ± 0·1° C

System		Dissociation constant of ligand			Stability constant of complex	
		pK_{COOH}	pK_{SH}	$pK_{NH_3^+}$	Log K_{ML_1}	Log K_{ML_2}
1. Uranyl ion-cysteine	..	1·65	8·27	10·66	9·04	..
2. Uranyl ion-methionine	..	2·12	..	9·05	7·45	6·30
3. Uranyl ion-N-acetyl glycine	..	3·65	..	..	3·30	..
4. Uranyl ion-thiosalicylic acid	..	5·10	..	..	4·60	3·91

(v) a complex involving only the COOH group and not involving the nitrogen atom was formed in uranyl - N-acetyl glycine system as evident from the stability value being comparable to that of complexes of uranyl ion with simple carboxylic acids[5,6]; and

(vi) the –SH group of thiosalicylic acid is probably involved in co-ordination to uranyl ion in addition to –COOH group as evidenced by the higher stability value of UO_2-thiosalicylic acid system than uranyl-N-acetyl glycine and development of red colouration. Our results agree with the earlier work of Kumar and co-workers[7] who reported only the composition of the complexes of uranyl ion-thiosalicylic acid to be 1 : 1 and 1 : 2.

We thank Dr. S. Ramamoorthy of our laboratory for the helpful discussions during the course of this work.

Dept. of Physical Chemistry, University of Madras, Madras-25, January 4, 1970.
A. RAGHAVAN.
M. SANTAPPA.

1. Greenstein, J. P. and Winitz, M., *Chemistry of the Amino-Acids*, 1961, **1**, 476.
2. Irving, H. M. and Rossotti, H. S., *J. Chem. Soc.*, 1954, p. 2904; *Ibid.*, 1953, p. 3397.
3. Albert, A., *Biochem. J.*, 1952, **50**, 693.
4. Rossotti, F. J. C. and Rossotti, H. S., *Acta Chem. Scand.*, 1955, **9**, 1166.
5. Ramamoorthy, S. and Santappa, M., *Bull. Chem. Soc., Japan*, 1969, **42**, 411.
6. —, Raghavan, A. and Santappa, M., *J. Inorg. Nucl. Chem.*, 1969, **31**, 1765.
7. Kumar, A. N., Nigam, H. L. and Katyal, M., *Bull. Chem. Soc., Japan*, 1967, **40**, 788.

A TECHNIQUE FOR THE SEPARATION OF OVERLAPPING AMINO-ACIDS

Any unidimensional chromatography method can be applied directly to the circular paper technique as far as solvent and location reagents are concerned. But one great drawback of this circular paper chromatography[1] is that the same chromatogram cannot be easily used for two-dimensional separation with different solvent mixtures as is possible with a rectangular paper. To separate the amino-acids, overlapping even after multiple development with one type of solvent mixture, the mixed band has to be rechromatographed on a separate paper. Different techniques have been used for this purpose.[2-4] In all these techniques the mixed band separates into circles or arcs, due to the additional factor of radial force operating. This force spreads the solvent and the substance over the paper as a progressively enlarging arc resulting in considerable weakening of the colour that develops after staining. These arcs of weakly coloured bands do not permit easy densitometric evaluation. The technique of Giri *et al.*,[2] besides the above disadvantage, needs additional time for transferring the mixed band to another paper and then running the chromatogram. Also the worker is constantly engaged in keeping the spot within dimension.

These difficulties can be overcome by combining the circular and the ascending types of chromatography for the first and second developments respectively giving a two-dimensional effect. From the centre of Whatman No. 1 circular paper a circle with a radius of 3 cm. was drawn and divided into six sectors as seen in Chromatogram No. 1. The marker sectors I and IV were spotted with known strength of mixtures of glutamic acid and threonine, aspartic acid, serine and glycine respectively. Amino-acid mixture solution of known strength was then spotted on the remaining sectors. The chromatogram was developed with n-butanol-acetic acid-water (4 : 1 : 1·6) for 6–8 hours. After drying, the marker sectors were cut from the periphery upto the circle and stained with ninhydrine. The corresponding band of glutamic acid and threonine was marked as an arc on the adjacent unstained sectors by a compass using original spot of

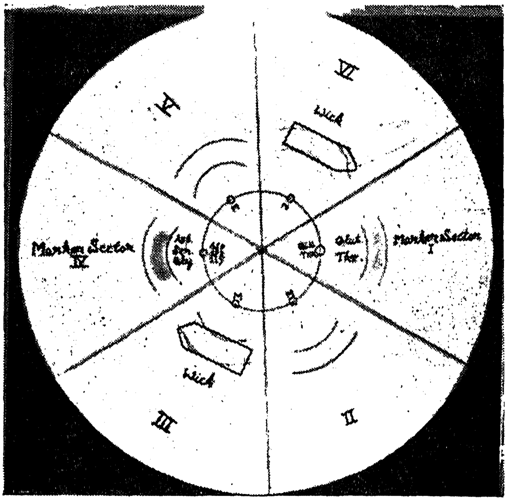


FIG. 1. Circular Paper chromatogram No. 1. in butanol acetic acid : water, showing sectors I-VI. Marker sectors I and IV stained with ninhydrine. *Glut.* —Glutamic acid *Thr* — Threonine ; *Asp.* —Aspartic acid ; *Ser*—Serine, *Gly*—Glycine, Sectors III and VI show mapping and shaping of the wick. *M*—Amino-acid mixture.

The authors are thankful to Prof. J. Bhimasenachar for his interest and encouragement. One of them (S. M.) is thankful to C.S.I.R. for awarding a Junior Research Fellowship.

Department of Physics, S. MOHAN.
S.V. University, P. JAYARAMA REDDY.
Tirupati, *January* 9, 1970.

---

1. Chopra, K. L. and Bahl, S. K., *J. Appl. Phys.*, 1967, **38**, **3607**.
2. Parikh, D. O. and Naik, Y. G., *Indian J. Pure Appl. Phys.*, 1968, **6**, **437**.
3. Fuchs, K., *Proc. Cambridge Phil. Soc.*, 1938, **34**, **100**.
4. Sondheimer, E. H., *Phys. Rev.*, 1950, **80**, **401**.
5. —, *Advan. Phys.*, 1952, **1**, **1**.

COMPLEXES OF URANYL ION WITH SOME AMINO AND MERCAPTO ACIDS

SYSTEMATIC aqueous pH titrations at 30° ± 0·1° C. and μ 0·1 M ($NaClO_4$) on systems of uranyl ion—cysteine; methionine; N-acetyl glycine and thiosalicylic acids have been carried out by us with a view to determine the composition(s) and stability constant(s) of complex(es) formed. The chemicals used were all of AnalaR grades. The pH meter (Universal Pye; cat. 10085) with a built-in calomel glass electrode was used and the recorded pH values were accurate to ± 0·02. Data of pH > 3·5 (hydrolysis) were not used in the calculations. Due to the low solubility of thiosalicylic acid in water, a 50% dioxan-water mixture was used for that system only. Dissociation constants of the ligand acids were determined by the conventional method[1] for amino-acids and by slope and intercept method due to Irving and Rossotti[2] for other acid ligands. Values of $\bar{n}$ and pL were calculated from the pH titration curves by the method adopted by Albert[3] for amino-acids and that by Irving and Rossotti[2] for other systems. Values of the stability constants of the metal complexes were evaluated from the slope and intercept[4] by least squares treatment (Table I and Fig. 1). The titrations were carried out over a twenty-fold variation in the total metal chelate concentration, in order to determine the presence of polymeric species.

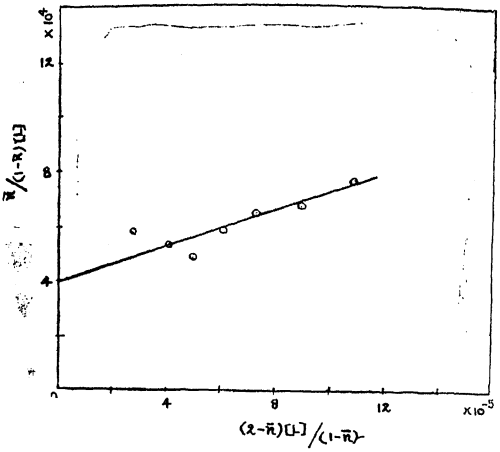


FIG. 1. Uranyl ion-thiosalicylic acid system.

μ=0·1 M ($NaClO_4$) T=30° ± 0·1° C

Plot of $\bar{n}/(1-\bar{n})$ [L] *versus* $(2-\bar{n})$ [L]/$(1-\bar{n})$

Slope = K_{ML1} K_{ML_2}
= $3{\cdot}235 \times 10^8$
Intercept = K_{ML_1}
= $4{\cdot}000 \times 10^4$

We conclude from our results that:

(*i*) 1 : 1 complexes were formed with cysteine and N-acetyl glycine;
(*ii*) 1 : 1 and 1 : 2 complexes were formed with methionine and thiosalicylic acids;
(*iii*) absence of polymeric species of the chelates was indicated by the observed decreasing K_{ML} values with increasing total metal chelate concentration (5×10^{-4} M to 1×10^{-2} M);
(*iv*) both amino and carboxylic groups are involved in co-ordination to uranyl ion with further stabilization by S atom in the case of cysteine and without stabilization by S in the case of methionine as evidenced from the order of stability constants (Table);

TABLE I

Equilibrium constants of systems of uranyl ion with some amino and mercapto acids

μ=0·1 M ($NaClO_4$) T=30° ± 0·1° C

System		Dissociation constant of ligand			Stability constant of complex	
		pK_{COOH}	pK_{SH}	pK_{NH_3+}	Log K_{ML_1}	Log K_{ML_2}
1. Uranyl ion-cysteine	..	1·65	8·27	10·66	9·04	..
2. Uranyl ion-methionine	..	2·12	..	9·05	7·45	6·30
3. Uranyl ion-N-acetyl glycine	..	3·65	..	..	3·30	..
4. Uranyl ion-thiosalicylic acid	..	5·10	..	..	4·60	3·91

(*v*) a complex involving only the COOH group and not involving the nitrogen atom was formed in uranyl - N-acetyl glycine system as evident from the stability value being comparable to that of complexes of uranyl ion with simple carboxylic acids[5,6]; and

(*vi*) the –SH group of thiosalicylic acid is probably involved in co-ordination to uranyl ion in addition to –COOH group as evidenced by the higher stability value of UO_2-thiosalicylic acid system than uranyl-N-acetyl glycine and development of red colouration. Our results agree with the earlier work of Kumar and co-workers[7] who reported only the composition of the complexes of uranyl ion-thiosalicylic acid to be 1 : 1 and 1 : 2.

We thank Dr. S. Ramamoorthy of our laboratory for the helpful discussions during the course of this work.

Dept. of Physical Chemistry, A. Raghavan.
University of Madras, M. Santappa.
Madras-25, *January* 4, 1970.

---

1. Greenstein, J. P. and Winitz, M., *Chemistry of the Amino-Acids*, 1961, **1**, 476.
2. Irving, H. M. and Rossotti, H. S., *J. Chem. Soc.*, **1954**, p. 2904; *Ibid.*, 1953, p. 3397.
3. Albert, A., *Biochem. J.*, **1952**, **50**, **693**.
4. Rossotti, F. J. C. and Rossotti, H. S., *Acta Chem. Scand.*, 1955, **9**, 1166.
5. Ramamoorthy, S. and Santappa, M., *Bull. Chem. Soc., Japan*, 1969, **42**, 411.
6. —, Raghavan, A. and Santappa, M., *J. Inorg. Nucl. Chem.*, 1969, **31**, 1765.
7. Kumar, A. N., Nigam, H. L. and Katyal, M., *Bull. Chem. Soc., Japan*, 1967, **40**, **788**.

A TECHNIQUE FOR THE SEPARATION OF OVERLAPPING AMINO-ACIDS

Any unidimensional chromatography method can be applied directly to the circular paper technique as far as solvent and location reagents are concerned. But one great drawback of this circular paper chromatography[1] is that the same chromatogram cannot be easily used for two-dimensional separation with different solvent mixtures as is possible with a rectangular paper. To separate the amino-acids, overlapping even after multiple development with one type of solvent mixture, the mixed band has to be rechromatographed on a separate paper. Different techniques have been used for this purpose.[2-4] In all these techniques the mixed band separates into circles or arcs, due to the additional factor of radial force operating. This force spreads the solvent and the substance over the paper as a progressively enlarging arc resulting in considerable weakening of the colour that develops after staining. These arcs of weakly coloured bands do not permit easy densitometric evaluation. The technique of Giri *et al.*,[2] besides the above disadvantage, needs additional time for transferring the mixed band to another paper and then running the chromatogram. Also the worker is constantly engaged in keeping the spot within dimension.

These difficulties can be overcome by combining the circular and the ascending types of chromatography for the first and second developments respectively giving a two-dimensional effect. From the centre of Whatman No. 1 circular paper a circle with a radius of 3 cm. was drawn and divided into six sectors as seen in Chromatogram No. 1. The marker sectors I and IV were spotted with known strength of mixtures of glutamic acid and threonine, aspartic acid, serine and glycine respectively. Amino-acid mixture solution of known strength was then spotted on the remaining sectors. The chromatogram was developed with *n*-butanol-acetic acid-water (4 : 1 : 1·6) for 6–8 hours. After drying, the marker sectors were cut from the periphery upto the circle and stained with ninhydrine. The corresponding band of glutamic acid and threonine was marked as an arc on the adjacent unstained sectors by a compass using original spot of

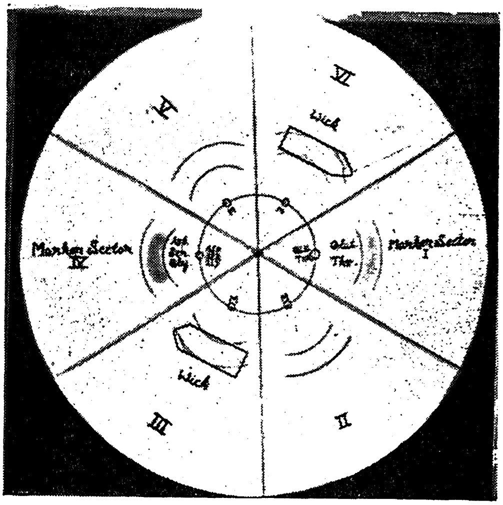


FIG. 1. Circular Paper chromatogram No. 1. in butanol acetic acid : water, showing sectors I-VI. Marker sectors I and IV stained with ninhydrine. *Glut.* —Glutamic acid *Thr* — Threonine ; *Asp.* —Aspartic acid ; *Ser*—Serine, *Gly*—Glycine, Sectors III and VI show mapping and shaping of the wick. *M*—Amino-acid mixture.

application as the centre. Similarly the single band of aspartic acid, serine and glycine was also mapped. These strips were then carefully and evenly cut out from the marked area on the paper incorporating the whole band of amino-acids in it as seen in Chromatogram No. 1. One end of the strip was cut to shape like a bottleneck for guiding the amino-acids along it during the second run. These strips were then stitched with a fine needle and thread to one end of the ascending Whatman No. 1. paper of 5″ × 15″ size at equidistance to serve as wicks. This specially prepared paper was then developed, in the usual ascending type of chromatography glass chamber, with either pyridine-water (80 : 20) or phenol-water (4 : 1) over the day or overnight. The length of time of this development could be adjusted according to R_f values of the amino-acids under separation. This time will vary with different individual substances. These five amino-acids which are not separable with any one type of solvent can thus be separated into distinct bands by using any one of the above two solvents as seen in Chromatogram No. 2.

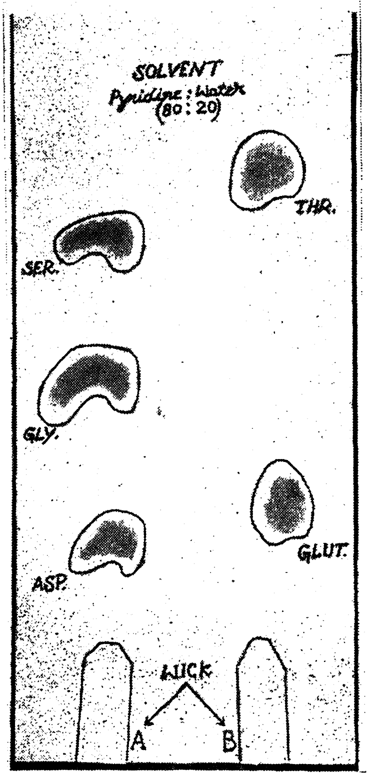


FIG. 2. Ascending Paper chromatogram No. 2 in Pyridine : Water, showing separation of the five amino-acids.

The strips to serve as wicks could be shaped and stitched variously, *e.g.*, horizontally or vertically. But as the wick is obtained from a circular paper with the radial force operating in its fibres, there is a tendency for the separated amino-acid bands to show trailing with maximum concentration of the substance towards the convex side of the cut-out arc. The best results with this modified technique were dependent on the preparation of a proper wick cut out evenly without any edges on the sides. The bottleneck type of the wick was most satisfactory for this purpose, which, besides counteracting the radial force, would allow the flow of the amino-acids through the narrow neck at the distal end. Colorimetric evaluations showed no loss of the substance quantitatively.

Department of Anatomy, V. A. SHINDE.
Pt. J.N.M. Medical College, T. N. MEHROTRA.
Raipur (M.P.) India, *January* 25, 1970.

---

1. Giri, K. V. and Radhakrishnan, A. N., *J. Indian Inst. Sci.*, 1953, **35** (2), 143.
2. — and Rao, N. A. N., *Ibid.*, 1953, **35** (4), 343.
3. Airan, J. W., *Curr. Sci.*, 1953, **22**, 51.
4. Shinde, V. A., Agarwal, I. P., Varma, S. C. L. and Jain, R. K., *Ibid.*, 1963, **32**, 118.

A NEW SPECIES OF *CERCOSPORA* CAUSING LEAF-BLIGHT OF *MARSILEA QUADRIFOLIATA*

Cercospora leaf-blight of *Marsilea quadrifoliata* L., a common weed growing on the bunds of wet lands and irrigation channels, was observed in South Arcot and Tanjore Districts. Serious incidence of the disease was noticed during November-February, 1968-69. Infected leaves soon dried giving a scorched appearance of the area in patches. Studies of the affected leaves revealed that a new species of *Cercospora* was responsible for the leaf-blight.

Cercospora marsileæ RAGUNATHAN, PRASAD AND PURUSHOTHAMAN SP. NOV.

Leaf spots brown to rusty brown with chlorotic halos often giving 'V'-shaped appearance with a deep brown centre, 2–14 mm. in length, sometimes spreading to the entire leaflet (Fig. 1). Fruiting amphigenous; stroma well developed consisting of brown cells; conidiophores in fascicles of 2–10 brown, pale near the apex, geniculate, with distinct scars, 1–3 septate, obtuse at tip, 4·0–5·0 × 48–94 μ; conidia hyaline, cylindrical, straight or curved, 4–26-septate, obtuse to sub-obtuse at tip, truncate at base, 4–5·5 × 45–224 μ (Fig. 2).

Habit: On living leaves of *Marsilea quadrifoliata* L.

Leg.: V. Ragunathan, November 5, 1965, Annamalainagar, Tamil Nadu.

Type specimens are deposited in the Herb. Crypt. Ind. Orient., IARI, New Delhi (Accession No. 29330).

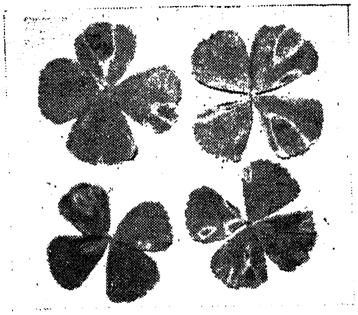


FIG. 1. Diseased leaves of *Marsilea quadrifoliata*.

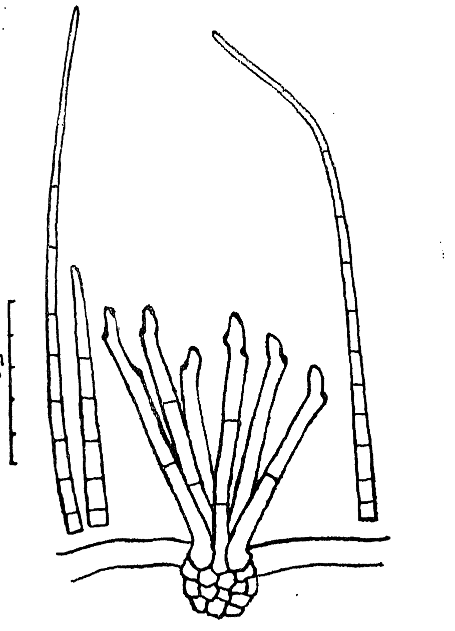


FIG. 2. Conidia and conidiophores of *Cercospora marsileæ*.

Cercospora marsileæ RAGUNATHAN, PRASAD AND PURUSHOTHAMAN SP. NOV.

Stromata in maculis foliaribus brunneis 'V' rubiginosobrunneis zona rhlorotira cinctis, 2-14 mm. longis, interdum trianguliformibus, medio atrobrunnea, nonnumquam folium totum occupantibus, producta, amphigena, matura e cellulis brunneis composita; conidiophora 2–10 in fasciculo instructa, brunnea, apicem versus pallida, geniculata, apice obtuso, 1–3-septata, distincte cicatricibus notata, 4·0–5·0 × 48–94 μ, conidia hyalina, cylindrica, recta vel curvula, 4–26 septata, ad apicem obtusa vel sub-obtusa, ad basim truncata, 4-5·5 × 45-224 μ.

In foliis vivis *Marsilea quadrifoliata* L. Leg. V. Ragunathan, November 5, 1965, prope Universitatem Annamalai, Annamalainagar, Tamil Nadu, India.

The fungus was isolated on carrot leaf agar medium. The pathogenicity of the fungus to its host was established. On inoculation, the following plants were not affected, *viz.*, *Oryza sativa* L., *Cynodon dactylon* Pers., *Cyperus rotundus* L., *Dolichos lablab* L., *Eclipta alba* (L.) Hassk., *Phaseolus mungo* L., *P. aureus* Roxb., and *Ipomœa aquatica* Forsk.

Leaf-blight of *Marsilea quadrifoliata* due to *Cercospora* sp. was first reported from this laboratory.[3] Further studies on its pathogenicity and host range revealed that the fungus was host-specific and hence the name *Cercospora marsileæ* has been proposed to recognise it as a new species. No report of *Cercospora* occurring on this host could be traced from the available literature.[1,2,4]

The authors are grateful to Dr. Donald P. Rogers, Professor of Botany, University of Illinois, U.S.A., for Latin diagnosis of the species.

Microbiology and Plant Pathology Section, V. RAGUNATHAN.
Faculty of Agriculture, N. N. PRASAD.
Annamalai University, D. PURUSHOTHAMAN.
Tamil Nadu, India, *October* 16, 1969.

---

1. Chupp, C., *A Monograph of the Fungus Genus* Cercospora, Ithaca, New York, 1953, p. 609.
2. Govindu, H. C. and Thirumalachar, M. J., *Dept. Agri. Mysore State Res. Bull.*, 1963, **7**, 1.
3. Ragunathan, V. and Prasad, N. N., *Annamalai Univ. Agri. Res. Annu.*, 1969, **1**, 116.
4. Vasudeva, R. S., *Indian Cercosporæ*, I.C.A.R., New Delhi, 1963, p. 245.

A NEW SPECIES OF *SCOLECOBASIDIUM*

A FUNGUS found growing on an earthen water pot was isolated in pure culture. This appears to be a new species of *Scolecobasidium* and is described below.

Scolecobasidium indicum SP. NOV.

The fungus formed irregular, scattered, and black patches on the surface of the pot. In pure culture, on P.D.A. the colonies are fluffy and dark olivaceous-brown. The vegetative hyphæ are hyaline to subhyaline, septate, smooth, about 1·5 μ wide, and form chlamydospores in chains. The conidiophores are simple, light olivaceous-brown, septate, straight or bent, short, 8–40 × 1·6–2·0 μ. The conidia are produced acrogenously, borne on a narrow connective, and mostly forming clusters. The connective is usually persistent on the conidiophore as a short narrow tube, but sometimes attached to the base of the conidium as a short frill. The conidia are usually 1-septate, guttulate, ovoid to short cylindric, conspicuously constricted at the septum, light olivaceous-brown, smooth, tapering to a narrow truncate base, and 7·6–16·0 × 3·2–5·2 μ. They germinate

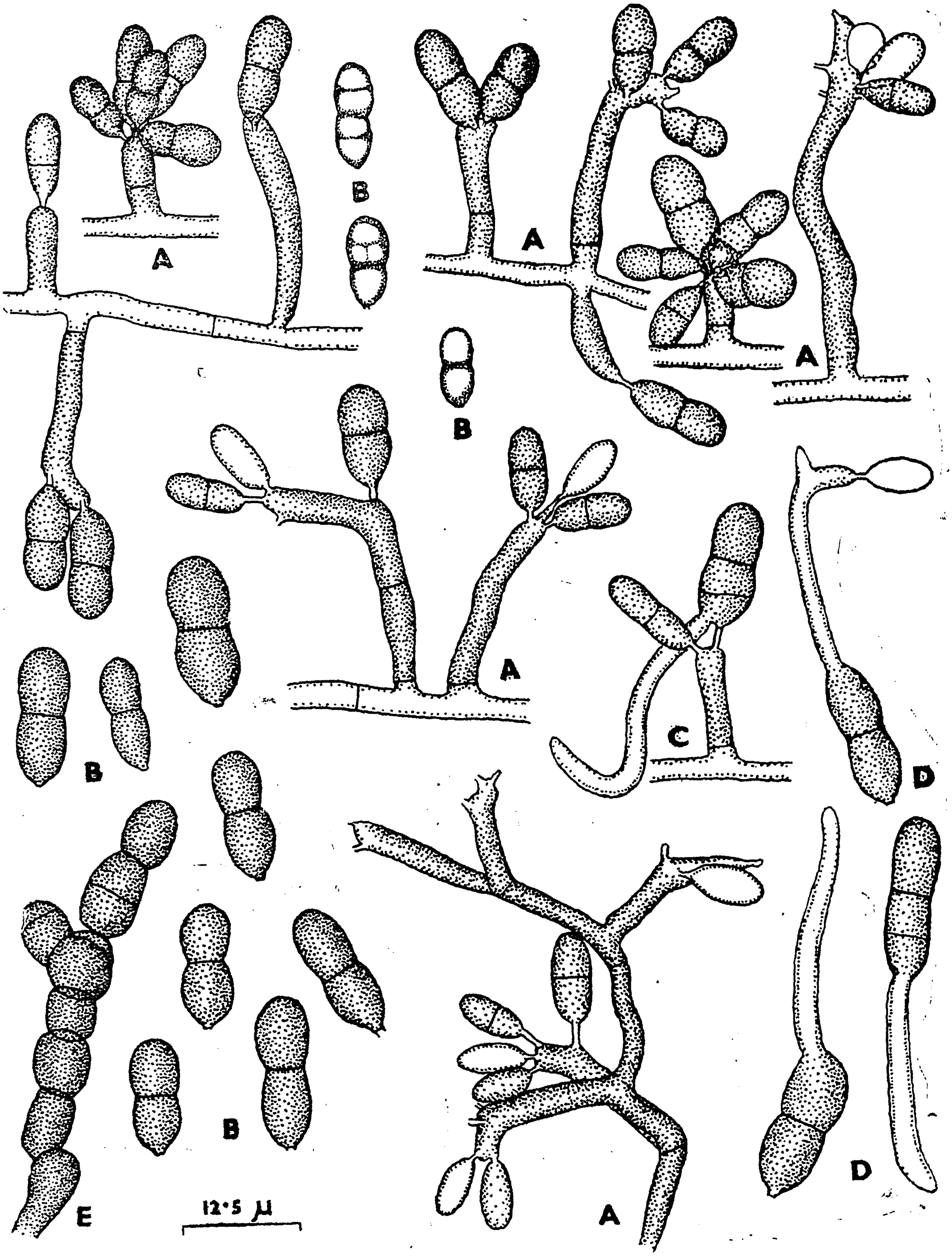


FIG. 1, A–E. *Scolecobasidium indicum* from type collection. A. Conidiophores with attached conidia. B. Conidia. C. A germinating conidium while still attached to the conidiophores. D. Conidia germinating. E. Chlamydospores.

either through the hilum or from any other point on the spore.

Scolecobasidium indicum resembles *S. constrictum* Abbott (Barron and Busch, 1962) in shape and size of the conidiophores, and in constricted nature of conidia. However, the conidia of *S. indicum* are smooth and 7·6–16·0 × 3·2–5·2 μ, whereas those of *S. constrictum* are echinulate to verrucose and 5·0–12·5 × 2–4 μ. *S. indicum* also resembles *S. humicola* Barron & Busch (Barron and Busch, 1962) in the size of the conidia, but the conidia of the latter are finely echinulated and rarely constricted at the septum. The conidia in the present fungus are smooth and always conspicuously constricted at the septum. Further, the conidiophores of *S. humicola* are up to 300 μ long while those of *S. indicum* are up to 40 μ long. *S. indicum*, therefore, is a distinct species which can be easily identified with its smooth and constricted conidia produced on short conidiophores. Since the combination of these features of this fungus does not agree with other known species of the genus, it is described here as a new species.

Hyphæ vegetativæ hyalinæ vel subhyalinæ, septatæ, *ca.* 1·5 μ latæ. Conidiophora simplicia, pallide olivaceo-brunnea, septata, cylindrica, recta vel curva, 8–40 × 1·6–2·0 μ. Conidia producta singulariter, acrogena, ut plurimum efformatia corymbos, connectivo angusto fixa; connectivum vulgo persistens conidiophoro fixum ut tubulus brevis angustusque, nonnumquam conidio fixum persistens ut segmentum breve hyalinum. Conidia vulgo uniseptata, ovoidea vel breviter cylindrica, eminenter constricta ad septum, pallide olivaceo-brunnea, levia, fastigata in basin angustam truncatam, 7·6–16·0 × 3·2–5·2 μ.

Typus lectus in aquæ vasa fictili ad Jodhpur in Rajasthania, mense martio anni 1963 a B.C. Lodha (Herb. R.U.B.L. No. 68).

I am deeply indebted to Professor C. V. Subramanian, University Botany Laboratory, Madras, for his guidance and suggestions during the preparation of this paper. I am also grateful to Rev. Father Dr. H. Santapau for his ready help in translating the diagnosis of this new taxa into Latin.

Department of Botany, B. C. Lodha.
University of Rajasthan,
Jaipur-4 (India), *November* 29, 1969.

---

1. Barron, G. L. and Busch, L. V., *Can. J. Bot.*, 1962, **40**, 77.

EFFECT OF CHLORIDE IONS ON GERM TUBE GROWTH OF *BOTRYTIS* SPP.

Ether extracts of acidified (with N.HCl) leaf exudates of *Vicia faba* caused significant inhibition of germ tube growth of *Botrytis fabœ* and *B. cinerea* as revealed from bioassay tests. It was, therefore, considered necessary to investigate whether this inhibition was primarily due to chloride ions of HCl or some other factors present in leaf exudate. Incidentally, the effect of sulphate and phosphate ions in ether extracts of acidified water on the growth of test organisms were also compared. Bioassay tests with acidified plant exudates sometimes show erroneous results due to the presence of minute quantities of unwanted ions even after extraction with diethyl ether. Hence it is desirable to check the influence of ions on the growth of test organisms. This work was undertaken with a view to ascertain the individual effect of chloride, sulphate and phosphate ions on the growth of micro-organisms after ether extraction of water containing different acids usually employed for acidification.

In the preliminary experiment ether extracts of both acidified and neutral (control) leaf exudates of bean were tested on the germ tube growth of the said fungi after dissolving the residue in phosphate buffer solution (0·01 M, pH 6). Both the exudates inhibited growth but markedly in case of acidified exudate. So in the second experiment, 300 ml. distilled water was taken in 3 conical flasks (100 ml./flask) and acidified with 0·4 ml. N. HCl, 0·15 ml. N. H_2SO_4, 0·65 ml. N. H_3PO_4 respectively. All acidulated water were adjusted to pH 3 and subsequently extracted separately with equal volume of diethyl ether (b.p. 60°–80° C.). After separation of the ether fraction, it was evaporated to complete dryness in a rotary film evaporator in room temperature (23–25° C). The residue in each case was dissolved in 2·5 ml. phosphate buffer solution and tested on both the species following the method used for the bioassay of antibiotics.[1] The spore suspension of fungi was prepared as described by Deverall and Wood[2] and 10 μl of either *B. fabœ* or *B. cinerea* (12 days old culture) was added to 100 μl. of the solution to be tested and incubated for 24 hrs. at 15–17° C. and 380 f.c. light. The results are given in Table I.

The results suggest that chloride ions have significant effect on the germ tube growth of the test species of *Botrytis*. The growth of

B. cinerea is more affected (about 50% reduction) than that of *B. fabœ* (about 40% reduction). However the rate of spore germination has been found to be nearly normal (as in buffer control) in all cases. The sulphate and phosphate ions have less effect on the germ tube growth under test conditions.

TABLE I

Effect of ether extracts of acidified water on the germ tube growth of B. fabæ *and* B. cinerea

Treatment*	Average length of germ tube (μ) †	
	B. fabœ	*B. cinerea*
Phosphate buffer (control) ..	281·61 (94–515)‡	187·44 (78–313)
Distilled water ..	273·35 (78–515)	171·82 (78–235)
Distilled water + HCl ..	167·13 (63–345)	93·72 (31–157)
Distilled water + H_2SO_4 ..	242·11 (110–345)	140·58 (63–219)
Distilled water + H_3PO_4 ..	210·87 (78–515)	139·01 (94–282)

*All ether extracts finally dissolved in phosphate buffer solution. † Average germ tube length based on 60 germ tubes. ‡ Range of length of germ tubes.

The author is grateful to Dr. B. J. Deverall, Department of Botany, Imperial College of Science and Technology, London, for his valuable suggestions and for providing necessary facilities to carry out this investigation.

Department of Botany, R. P. PURKAYASTHA.
Univ. College of Science,
35, Ballygunge Circular Road,
Calcutta-19, *December* 10, 1969.

---

1. Purkayastha, B. P., *Curr. Sci.*, 1969, **38**, 172.
2. Deverall, R. J. and Wood, R. K. S., *Ann. Appl. Biol.*, 1961, **49**, 461.

ROLE OF AFLATOXINS IN GROUNDNUT SEED SPOILAGE

AFLATOXINS are a series of metabolites produced by some strains of *Aspergillus* spp. associated with the spoilage of agricultural commodities. The compounds are acutely toxic to poultry, calves, swine, monkeys and even to human beings.[1] Bampton[2] and McDonald and Harkness[3] reported the growth of *Aspergillus flavus* and production of aflatoxin in groundnuts. *A. fumigatus* has been reported by Sreenivasamurthy *et al.*[4] as the aflatoxin producing fungus in groundnut. The authors, working on the seed-borne microflora of groundnut, isolated eight species of *Aspergillus* from the stored pods and kernels and those species were found to cause seed germination failures and reduction in seedling vigour. Hence studies were undertaken to assess the possible role of aflatoxin, the toxin which affected animal species, in the seed germination failures.

The ability to produce aflatoxins by the *Aspergillus* spp. was tested.[4,5] The effect of the toxins on the seed germination and seedling vigour of groundnut was assessed by the method described by Vidhyasekaran *et al.*[6]

The data in Table I reveal that only *A. flavus* and *A. tamarii* produced aflatoxin.

TABLE I

The presence of aflatoxins in the culture filtrates of various Aspergillus *spp.*

Species of *Aspergillus*	Presence of aflatoxins
A. nidulans	–
A. versicolor	–
A. flavus	+
A. tamarii	+
A. niger	–
A. fumigatus	–
A. variecolor	–
A. ustus	–

The culture filtrates of all the *Aspergillus* spp. tested did not inhibit the seed germination, but their effect was much pronounced on root and shoot elongations. All the aspergilli inhibited the root elongation more than 60% and *A. flavus*, *A. ustus* and *A. tamarii* inhibited the root elongation more than 90%. *A. flavus* inhibited shoot elongation also markedly and *A. versicolor* inhibited more than 60% shoot elongation (Table II).

Armbrecht *et al.*[7] reported production of aflatoxin by several *A. flavus* strains. Codner *et al.*[8] obtained production of as much as 265 mg. of aflatoxin/kg. of peanuts by *A. parasiticus* and smaller amounts by five strains of *A. flavus*. *A. fumigatus* has also been reported to produce the toxins.[4]

In the present studies, *A. tamarii* was also found to produce the aflatoxins.

Although only two of the species of *Aspergillus* tested were found to produce aflatoxins, all the aspergilli were observed to affect the seedling vigour markedly. Hence it may be concluded that the toxin produced by the aspergilli to inflict damage on the crop is different from the aflatoxin which is toxic to animal species. Only few species and few strains produce aflatoxins. Jackson[9] observed that matured peanuts were largely free from aflatoxin. But the toxins produced by these

TABLE II

Effect of culture filtrates of different Aspergillus *spp. on seed germination and seedling vigour*

Culture filtrate	Germination: Germination percentage	Germination: % reduction over un-inoculated medium	Root elongation: Root length in mm.	Root elongation: % reduction over un-inoculated medium	Shoot elongation: Shoot length in mm.	Shoot elongation: % reduction over un-inoculated medium
1. *A. nidulans* ..	85·0	15·0	7·0	79·7	29·2	45·0
2. *A. versicolor* ..	85·0	15·0	7·4	78·5	16·7	68·5
3. *A. flavus* ..	81·7	18·3	0·5	99·5	1·4	97·4
4. *A. tamarii* ..	90·0	10·0	3·0	91·3	29·8	43·9
5. *A. niger* ..	80·0	20·0	6·8	80·2	41·5	21·8
6. *A. fumigatus* ..	88·3	11·7	12·8	62·8	41·1	22·6
7. *A. variecolor* ..	86·7	13·3	11·8	65·7	37·2	29·9
8. *A. ustus* ..	88·3	11·7	2·3	93·3	26·2	50·7
9. Uninoculated medium	100·0	..	34·4	..	53·1	..
10. Sterile water ..	100·0	..	35·5	..	55·0	..

aspergilli to affect the groundnut seedling vigour are very serious since all the *Aspergillus* spp. isolated from groundnut inflicted severe damage to the crop.

Division of Plant Pathology,
Agricultural College and Research Institute,
Coimbatore-3, *December* 16, 1969.

D. LALITHAKUMARI.
C. V. GOVINDASWAMY.
P. VIDHYASEKARAN.

---

1. Suryanarayana Rao, *Sci. Reptr.*, 1968, p. 338.
2. Bampton, S. S., *Trop. Sci.*, 1963, **5**, 74.
3. McDonald, C. and Harkness, C., *Ibid.*, 1964, **6**, 12.
4. Sreenivasamurthy, V., Jayaraman, A. and Parpia, H. A. P., *Ind. J. of Tech.*, 1961, **2**, 415.
5. Basappa, S. C., Jayaraman, A., Sreenivasamurthy, V. and Parpia, H. A. B., *Ind. J. Exp. Biol.*, 1967, **5**, 262.
6. Vidhyasekaran, P., Subramanian, C. L. and Govindaswamy, C. V., *Indian Phytopath.*, 1969 (In press).
7. Armbrecht, B. H., Hodges, F. A., Smith, H. R. and Nelson, A. A., *J. Ass. Offic. Agr. Chemists*, 1963, **46**, 805.
8. Codner, R., Sargeant, K. and Yeo, R., *Biotechnol. Bioeng.*, 1963, **5**, 185.
9. Jackson, C. R., *Phytopathology*, 1967, **57**, 1270.

A RARE CASE OF MONOZYGOTIC SYNCHORIAL TWINS IN THE VESPERTILIONID BAT, *PIPISTRELLUS CEYLONICUS CHRYSOTHRIX* (WROUGHTON)

Pipistrellus ceylonicus chrysothrix (Wroughton), like all other vespertilionid bats, has a perfectly bilaterally symmetrical bicornuate uterus. During each reproductive cycle an ovum is released from each of the ovaries, and each uterine cornu bears a single conceptus. The embryo is normally located at about the middle of the length of the uterus. During the course of the study of the sex-cycle and embryology of this species it was found that out of 355 pregnant females examined only four had three conceptuses each. In three of these the right uterine cornu bore two embryos and the left one, and in one female the left uterine cornu bore two embryos and the right had one. In all these cases each ovary had released as many ova as there were embryos in the uterine cornu of the corresponding side as evidenced by the fact that the number of corpora lutea in each ovary was the same as the number of embryos in the corresponding uterine cornu. In each of these cases the uterine cornu bearing two embryos showed the two swellings in a cranio-caudal sequence along the length of the uterus.

The present paper embodies description of a very exceptional female specimen of *Pipistrellus ceylonicus chrysothrix* in which there was a single swelling in each of the uterine cornua but which, on sectioning, showed that, whereas in the left uterine cornu there was a normal embryo in the neural groove stage of development (Fig. 1), the right cornu contained synchorial twin embryos, which were also in the neural groove stage of development (Fig. 2). When the ovaries were examined it was noticed that each ovary contained a single corpus luteum indicating that a single ovum had been released from each ovary. This clearly demonstrates that the twin embryos in the right uterine cornu were unquestionably monozygotic. In the twin embryos the two embryonic discs were at the same level in the uterus, and were placed diametrically opposite to each other, and they occupied the two sides of the uterus. A common chorionic sac encloses the two embryos, and each embryo is provided with its own complete amnion, which arches over the dorsal aspect of the embryo. The yolk-sac wall is in contact with the uterine wall on all the sides of the uterus so that the uterine lumen at the level of the uterus, where the twin embryos are present, is completely obliterated and is replaced by a wide, common yolk-sac cavity. The extra-embryonic mesoderm carrying vitelline vessels has extended all round the common yolk-sac wall, and an extensive chorio-vitelline placenta is present on all the sides of the uterus except on the dorsal sides of the two embryonic discs, where well-developed pre-placentæ are present.

The embryo in the left uterine cornu is normal and has a structure typical for vespertilionid bats at that stage of development. The embryonic disc is antimesometrially oriented, and the extra-embryonic mesoderm carrying vitelline vessels has extended only up to about half the distance from the embryonic region so that the chorio-vitelline placenta is present only on the sides of the uterus. The bilaminar omphalopleure hangs freely in the uterine lumen towards the mesometrial side thus leaving a part of the uterine lumen unoccupied by the embryo on the mesometrial side. Numerous uterine glands open into this part of the uterine lumen.

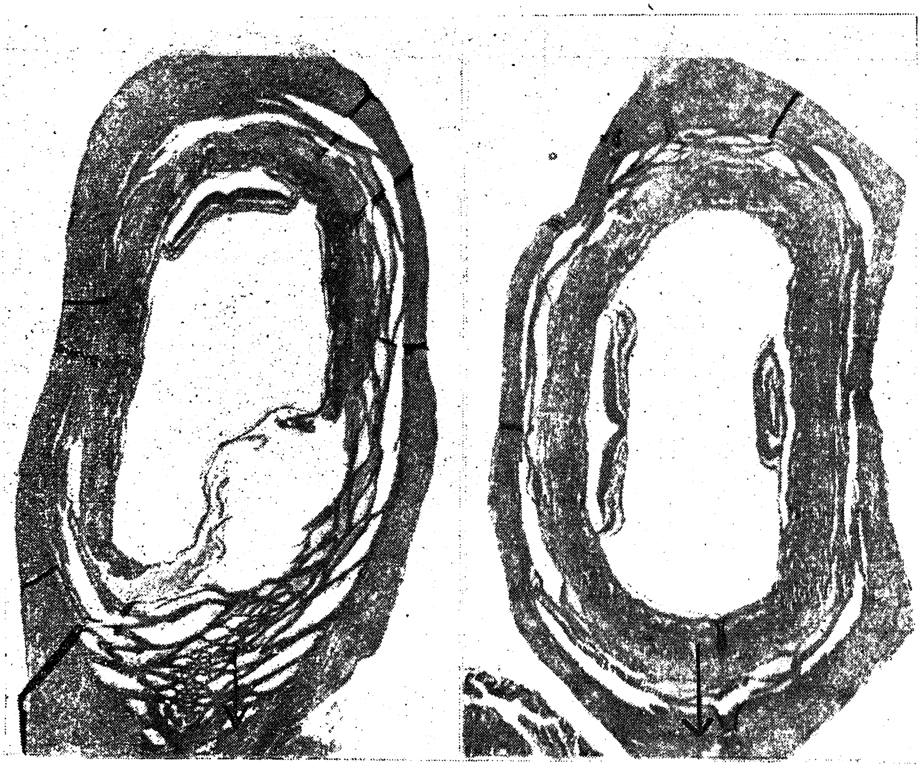


FIG. 1 FIG. 2

FIGS. 1–2. Fig. 1. Transverse sections of the left uterine cornu containing a normal embryo of the female specimen under study. The arrow points mesometrially. See text for description, × 40. Fig. 2. Transverse section of the right uterine cornu containing the monozygotic synchorial twins. The arrow points mesometrially. See text for description, × 40.

Apart from the fact that this is the first record of the occurrence of monozygotic synchorial twins in a bat, it opens the question of considerable theoretical interest concerning the physiological relationship between the uterus and the embryo in the vespertilionid bats. Whereas in all vespertilionids the embryo at implantation is so oriented that the embryonic disc is invariably towards the antimesometrial side of the uterus, this relationship seems to become disturbed if two embryos implant at the same level of the uterus. Since the normal antimesometrial side cannot contain both the embryos at the same level it appears that the twin embryos adopt the nearest compromise by being laterally oriented. It is also evident that the uterine wall on the mesometrial side is physiologically refractory for the implantation of the blastocyst in the vespertilionids.

Department of Zoology, A. GOPALAKRISHNA.
College of Science, R. B. PHANSALKAR.
Nagpur, *January* 31, 1970.

REVIEWS AND NOTICES OF BOOKS

Handbook of Neurochemistry (Vol. 2)—*Structural Neurochemistry.* (Plenum Publishing Corporation, 227, West 17th Street, New York, New York 10011, U.S.A.), 1969. Pp. xxix + 579. Price $ 35.00.

The book under review is the second volume of a seven-volume encyclopedic treatise. It presents an up-to-date evaluation of available chemical and biological knowledge about the nervous system and brain function.

The subject-matter in this volume has been dealt with in twenty-three chapters, *viz.*, 1. Water Spaces, by Hanna M. Pappius; 2. Water Movement, by Robert Katzman and Herbert Schimmel; 3. The Cerebrospinal Fluid, by Hugh Davson; 4. Choroid Plexus, by T. Z. Csaky; 5. Spinal Cord, by Giulio Levi; 6. The Use of Brain Slices, by K. A. C. Elliott; 7. Electrical Phenomena and Isolated Tissues from the Brain, by John A. Harvey and Henry McIlwain; 8. DNA Metabolism and Cell Proliferation; 9. Neurons and Glia: Separation Techniques and Biochemical Interrelationships, by Steven P. R. Rose; 10. Chemistry of Isolated Invertebrate Neurons, by Ezio Giacobini; 11. Nuclei, by D. A. Rappoport, P. Maxcy, Jr., and H. F. Daginawala; 12. Lysosomes, by Harold Koenig; 13. Brain Mitochondria, by Leo G. Abood; 14. The Synaptosome, by V. P. Whittaker; 15. Structural Components of the Synaptic Region, by Eduardo De Robertis and Georgina Rodriguez de Lores Arnaiz; 16. Peripheral Nerve, by Giuseppe Porcellati; 17. Nucleic Acid and Protein Metabolism of the Axon, by Edward Koenig; 18. Axoplasmic Transport, by Samuel H. Barondes; 19. Compartmentation of Amino-Acid Metabolism, by S. Berl and D. D. Clarke; 20. Metabolic and Anatomical Specialization within the Retina, by Richard N. Lolley; 21. Metabolic Information Derived from Radioautography, by B. Droz; 22. Enzyme Histochemistry: Applications and Pitfalls, by C. W. M. Adams; and 23. Neurochemistry of Invertebrates, by G. A. Kerkut.

This volume will serve as a reference source for anatomists, biochemists, biologists, biophysicists, medical research workers, neurochemists, neurophysiologists, and all scientists concerned with research on the brain and nervous system. C. V. R.

Treatise on Coatings (Vol. 2)—*Characterization of Coatings: Physical Techniques.* Part I. Edited by Raymond R. Myers and J. S. Long. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xxi + 669. Price $ 39.75; £ 18.18.0.

Treatise on Coatings enters a new area of practical information with the publication of *Characterization of Coatings: Physical Techniques.* Carrying on the work begun more than two decades ago by J. J. Mattiello, Volume 2 (in two parts) reveals above all that the basic devices used for the evaluation of coatings have undergone a revolution.

The two editors are the former and present Director of the Paint Research Institute, whose support of fundamental research in areas pertaining to coatings is responsible for many of the developments of the last decade. This part of the treatise will appeal to the research-oriented individual, yet it has been keyed to the needs of the laboratory assistant, technician, and superintendent.

The contents of this book under review are: 1. The Intrinsic Properties of Polymers, by A. R. H. Tawn; 2. Surface Areas, by David M. Gans; 3. Adhesion of Coatings, by Armand F. Lewis and Lloyd J. Forrestal; 4. Mechanical Properties of Coatings, by Percy E. Pierce; 5. The Ultimate Tensile Properties of Paint Films, by Robert M. Evans; 6. Gas Chromatography, by J. K. Haken; 7. Thermoanalytical Techniques, by Paul D. Garn; 8. Microscopy in Coatings and Coating Ingredients, by W. K. Lind; 9. Radioactive Isotopes, by Gordon R. Coe; 10. Infrared Spectroscopy, by Clara D. Smith; 11. Ultraviolet and Visible Spectroscopy, by Frank Spagnolo and Edward R. Scheffer; 12. Color of Polymers and Pigmented Systems, by George W. Ingle; and 13. Photoelastic Coatings, by Alexandre Blumstein.

C. V. R.

Solid State Surface Science. Edited by Mino Green. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 420. Price $ 18.16; £ 8 16 *sh.* 0 *d.*

The Solid State Surface Series fills the need for critical and provocative essays on the properties of the surfaces of solids. It shows the vast range of chemistry, physics, and theoretical and experimental techniques required to gain insight into the behavior of a phase boundary. The contributors are all authorities in their specialities.

The first chapter, on chemisorbed hydrogen, comes from the famous Japanese school led by Professor Horiuti. The second chapter, Transport and Scattering near Crystal Surfaces, by Dr. R. F. Greene, goes well past the Boltzmann-Fuchs method for describing the influence of solid boundaries on the transport properties of free carriers.

Chapter 3 considers simple complexes on semiconductor surfaces, and has a bearing on the behavior of semiconductor surfaces useful in devices as well as on semiconductor catalysts. Chapter 4, Work Function: Measurements and Results, is a critical survey of the work function, which is an important yet often misused measurement of surface research. Chapter 5, on epitaxic films of lead chalcogenides and related compounds, is included in this series because of the importance of thin films in surface research.

The series demonstrates the breadth and interdisciplinary nature of the field, and will be a source of interest to many. It will be of value to all those concerned with surface research, from the fresh graduate to the experienced worker. C. V. R.

Annual Review of Nuclear Science (Vol. 19). Edited by Emilio Segre. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1969. Pp. v + 635. Price $ 8.50 in U.S.A.; $ 9.00 Foreign.

Volume 19 of this well-known series contains the following articles: 1. Rapid Chemical Separations, by Gunter Herrmann and Hans Otto Denschlag; 2. Mass Separation for Nuclear Reaction Studies, by R. Klapisch; 3. The Three-Nucleon Problem, by R. D. Amado; 4. Coupled-Channel Approach to Nuclear Reactions, by Taro Tamura; 5. Mechanisms of Radiation Mutagenesis in Cellular and Sub-Cellular Systems, by B. A. Bridges; 6. Boson Resonances, by I. Butterworth; 7. Pion-Nucleon Interactions, by R. G. Moorhouse; 8. Parity and Time-Reversal Invariance in Nuclear Physics, by Ernest M. Henley; 9. Nuclear Mass Relations, by G. T. Garvey; 10. Coulomb Energies, by J. A. Nolen, Jr., and J. P. Schiffer; 11. Muonic Atoms and Nuclear Structure, by C. S. Wu and Lawrence Wilets; and 12. Some Related Articles Appearing in other *Annual Reviews*. C. V. R.

High Magnetic Fields and Their Applications. (Institute of Physics and the Physical Society, 1 Lowther Gardens, Prince Consort Road, London S.W. 7), Pp. 169. Price 30 *sh.* (US $ 3.60).

This publication of The Institute of Physics and the Physical Society contains in condensed form the papers presented at the Fourth International Conference on High Magnetic Fields and Their Applications held, under the auspices of IUPAP in Nottingham from 17–19 September 1969. The thirty papers reported in this Conference booklet include the two full-length invited papers *Magneto-optics* by J. G. Mavroides, and *Ordre magnetique* by R. Pauthenet.

Although a transient publication, this timely booklet of the Conference proceedings will be of present value to workers in this field of research. A. S. G.

Books Received

Treatise on Invertebrate Paleontology. Part R, Vol. I, *Arthropoda 4.* Edited by R. C. Moore. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado). Vol. I: Pp. xxxvi + R 398. Price $ 19.00; Vol. II: Pp. ii + R 400–R 651. Price $ 19.00.

Concepts and Models of Biomathematics (Vol. I). By F. Heinmets. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xi + 287. Price $ 16.75.

Annual Review of Physiology (Vol. 32). (Annual Reviews, Inc., 4139, El Camino Way, California 94306), 1970. Pp. ix + 636. Price $ 10.00 in U.S.A.; $ 10.50 Foreign.

Inaugural Edition—Physician's Book Compendium 1969-1970. By MaxCelnik. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y.), 1970. Pp. xxvi + 846. Price $ 29.50.

Cationic Surfactants. Edited by E. Jungermann. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1970. Pp. xiv + 652. Price 37.50.

Fungi of South India. By G. Rangaswami, V. S. Seshadri and K. A. Lucy Chennamma. (University of Agricultural Sciences, Hebbal, Bangalore-24), 1970. Pp. xv + 193.

2085-70 Published by S. R. S. Sastry, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

MAGNETIC BEHAVIOUR OF BASALTS CONTAINING VERY FINE SINGLE DOMAIN GRAINS

C. RADHAKRISHNAMURTY AND S. D. LIKHITE
Tata Institute of Fundamental Research, Bombay-5

INTRODUCTION

FROM several different types of studies[1-3] carried out in the past few years, it has been established that many basalts contain magnetite or titanomagnetite in the form of single domain grains. Some basalts show low field hysteresis loops, also called Rayleigh loops[4] and this has been attributed[5,6] to the presence of fine single domain grains which have relaxation times of the order of experimental durations or in other words blocking temperatures just above that of room temperature. The possibility that a few rocks may contain still finer grains which are superparamagnetic at or even below room temperature is there but no attempt to detect these has been made till recently. Since the grain size of the magnetic mineral in basalts can cover a wide range (from the smallest upto a hundred microns) the technique should be able to detect the superparamagnetic particles in the presence of other single and/or multi domain grains. It is well known that big single domain grains can be made to show superparamagnetism at an appropriate elevated temperature or the very fine ones to behave like big ones by cooling. Following the experiments described in the next section, a simplified procedure to detect the presence of superparamagnetic particles in rocks is given.

EXPERIMENTS AND RESULTS

By studying the low field hysteresis, basalts showing wide Rayleigh loops have been separated. These specimens were heated to 100° C. either in an oven or by immersing in boiling water and their Rayleigh loops have been observed at this temperature. Typical examples of the low field hysteresis behaviour of two specimens are given in Fig. 1. It is interesting to note that the specimen K 3 shows much reduced intensity of magnetization and negligible amount of hysteresis (Fig. 1 *a* II) at 100° C. whereas 708 shows more intensity at the same temperature.

The low field susceptibility *versus* temperature curves, referred to as $k(T)$ curves, in the range 4-175° C. for K 3 and 708 are shown in Fig. 1 *a* III and *b* III respectively. These are the single domain (SD) type curves proposed earlier,[3] with k-peaks as 20° C. for K 3 and 135° C. for 708. It can be inferred from the $k(T)$ curves that specimen K 3 contains many grains that are superparamagnetic at room temperature whereas such a state can be obtained for 708 at 135° C.

The values of susceptibility at 25° C. and 100° C. for K 3 are 0·26 and 0·06; the same for 708 are 0·43 and 0·81 (all in units of $\times 10^{-3}$ CGS) respectively. Thus measurement of susceptibility at two different temperatures itself provides a method for isolating basalts that have superparamagnetic particles at about the room temperature.

The hysteresis loops of the specimens in a field of 200 Oe at different temperatures have been studied. The method consisted of cooling the specimen to the desired temperature in a Dewar flask and then quickly transferring it into the specimen holder of the hysteresis loop tracer. The hysteresis loop of the specimen can be photographed within ten seconds from the time it was taken out of the Dewar flask and hence it could be considered that the temperature of the specimen to be almost the same as that when it was in the flask.

A set of hysteresis loops obtained for the specimen K 3 are given in Fig. 2.

DISCUSSION

It is interesting to note that the specimen nearly gets saturated (Fig. 2 *a*) even in a field of 200 Oe at 25° C. which means that most of the grains have coercive force much less than the applied field. Also the remanence ratio R (ratio of remanent intensity to the saturation value) is considerably less than 0·5 expected for a specimen containing randomly distributed single domain grains.[7] In this case the main obvious reason is the presence of superparamagnetic particles. At − 70° C. the hysteresis loop (Fig. 2 *b*) quite resembles that of the single domain grains with R value very close to 0·5. As the temperature is lowered to − 150° C. it shows more coercive force which is expected,[8] being 100 Oe (Fig. 2 *c*) and a reduced intensity of magnetization which could be due to less number of grains contributing. At − 190° C. the specimen does not show any hysteresis (Fig. 2 *d*) which can be explained by the fact that almost all the grains would have coercive force much greater than the applied field of 200 Oe.

A dramatic development of the hysteresis phenomena shown by the specimen can be seen on the oscilloscope screen when it is cooled to − 190° C. and allowed to warm up in the apparatus itself. The loops given in Fig. 2 are a few stages chosen to illustrate the hysteresis shown by a specimen containing a mixture of superparamagnetic and single domain particles.

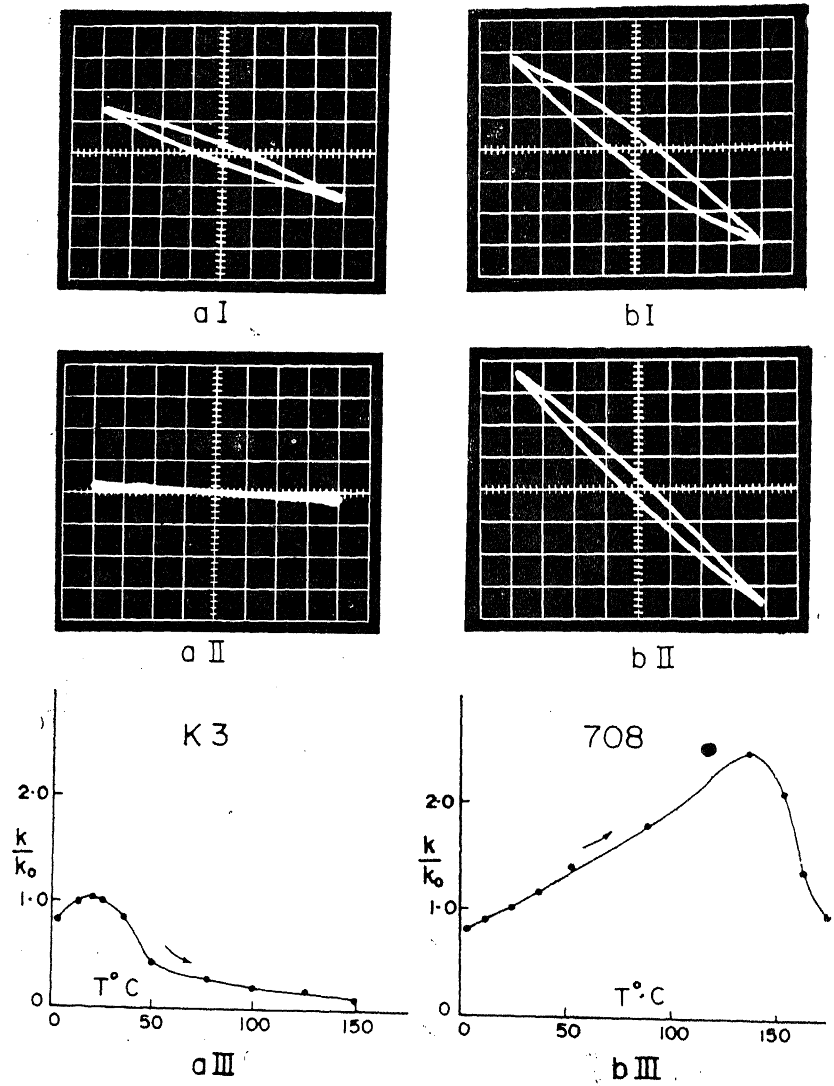


FIG. 1. Rayleigh loops and *k* (T) curves for two specimens K3 and 708. Scale for *a* I, *b* I, *a* II and *b* II, X-axis (magnetic field) 1 small division = 0·5 Oe, Y-axis (magnetic moment) 1 S.D. = 0·06 emu.

The following procedure emerges from the experiments described above:

1. Select rocks showing wide Rayleigh loops (like those in Fig. 1 *a* I and *b* I).
2. Study the Rayleigh loops of the specimens at 100° C.

Rocks which show reduced Rayleigh loops (like Fig. *a* II) at 100° C. contain predominently superparamagnetic particles. It may be mentioned here that all the samples showing wide Rayleigh loops do have some superparamagnetic grains.

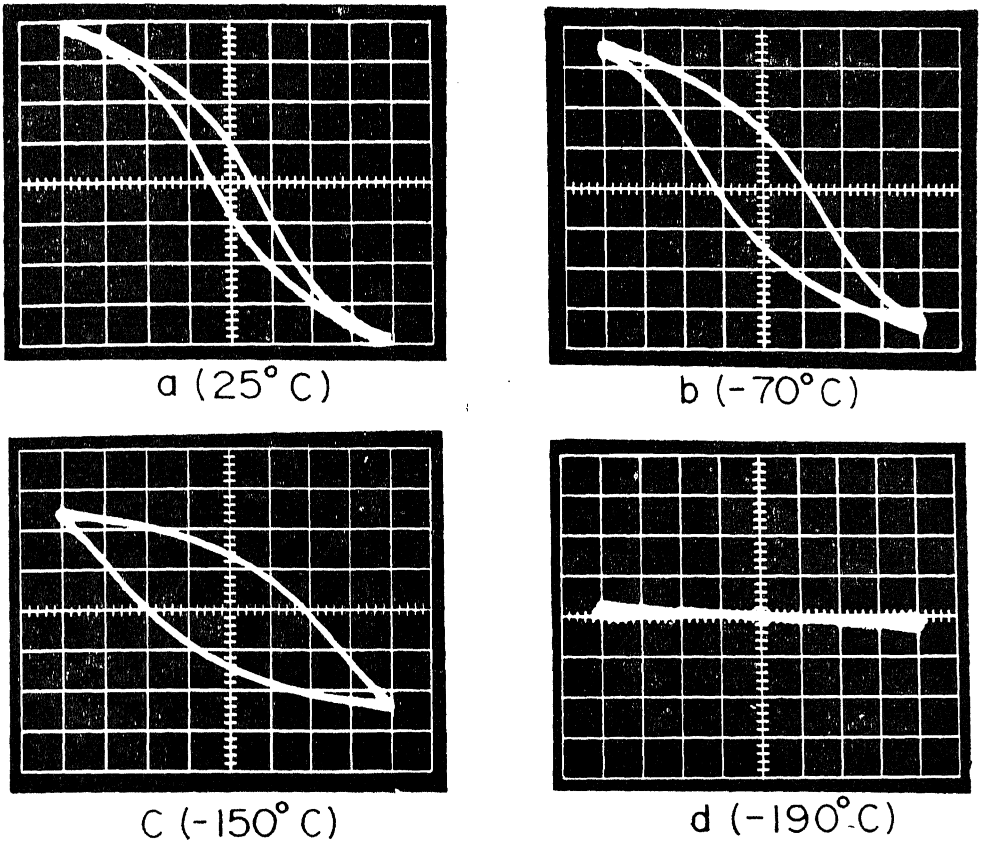

a (25° C)
b (-70° C)
C (-150° C)
d (-190° C)

FIG. 2. Hysteresis loops of K3 at different temperatures in a field of 200 Oe. Scale X-axis 1 S.D. = 10 Oe, Y-axis 1 S.D. = 0·25 emu.

CONCLUSIONS

It has been shown that some basaltic rocks contain predominently superparamagnetic particles even at room temperature and these can be separated by a few simple experiments.

The hysteresis phenomena shown by a random distribution of single domain grains are dramatically revealed by basalts containing superparamagnetic particles when cooled to different temperatures.

ACKNOWLEDGEMENTS

We record our thanks to Professor D. Lal for his keen interest in this work and Dr. N. P. Sastry for many useful discussions.

---

1. Stacey, F. D., *Earth Planet, Sci. Lett.*, 1967, **2**, 67.
2. Radhakrishnamurty, C., Likhite, S. D. and Sabasrabudhe, P. W., *Palæogeophysics*, Academic Press, London, 1970, p. 223.
3. — and —, *Earth Planet, Sci. Lett.*, 1970, **7**, 389.
4. — and —, *Curr. Sci.*, 1966, **35**, 534.
5. — and Sastry, N. P., *Proc. Ind. Acad. Sci.*, 1970 (In press).
6. Neel, L., *Comptes Rendus*, 1970 (In press).
7. —, *Adv. Phys.*, 1955, **4**, 191.
8. Morrish, A. H. and Watt, L. A., *Jour. Appl. Phys.*, 1958, **29**, 1029.

CHANGES IN THE STRUCTURE OF A CATALYST DURING A CATALYTIC REACTION-DEHYDROGENATION OF CYCLOHEXANOL ON NICKEL OXIDE

A. V. RAMASWAMY, P. RATNASAMY,* AND L. M. YEDDANAPALLI

Department of Chemistry, Loyola College, Madras-34

ABSTRACT

Cyclohexanol has been dehydrogenated to cyclohexanone and phenol over nickel oxide. Above 370° C., the electrical conductivity of the solid decreases in the presence of cyclohexanol. It subsequently registers an increase and finally attains a value characteristic of metallic samples. While no hydrogen is adsorbed on nickel oxide at 25° C., the sample after usage in the reaction adsorbs considerable amounts of hydrogen. The adsorption isotherm of hydrogen is quite similar to that observed in the case of metals. It is, therefore, inferred that during the reaction, the catalyst undergoes reduction to the metallic state.

INTRODUCTION

In any catalytic process, the solid catalyst does not play the role of an inert substance on which the chemical reaction proceeds but the role of an active participant in one of the intermediate stages of the reaction. It is a characteristic and in fact, a distinctive feature of a catalytic process that at the end of the reaction, the catalyst is completely regenerated. However, in some cases, the composition of the catalyst itself does change to some extent in the reaction process. Thus, many reactions catalysed by solid oxides are usually accompanied by oxidation or reduction of the catalysts.[1] As the reaction proceeds, the degree and sometimes the nature as well of the stoichiometric disturbance may change. Boreskov and Matveyev[2] investigated the decomposition of methyl alcohol to carbon monoxide and hydrogen on zinc oxide. They found that during the reaction process, zinc oxide became enriched in zinc in excess of stoichiometry and thus underwent reduction. In fact, changes in the electrical conductivity clearly indicated the attainment of metallic character by the sample during the catalytic reaction.

In the present study, cyclohexanol has been dehydrogenated to cyclohexanone and phenol over oxidized nickel oxide catalyst in the temperature range 300–410° C. The electrical conductivity of this material as well as changes in the electrical conductivity during the catalytic reactions have been measured. The results throw additional light on the changes in structure and composition that nickel oxide undergoes during the dehydrogenation reaction.

EXPERIMENTAL

Nickel oxide was prepared by the decomposition of nickel carbonate at 500° C. The catalytic reactions were carried out in a fixed bed, vertical, flow reactor. Adsorption studies were carried out in a conventional constant-volume adsorption apparatus. For conductivity measurements, the sample was taken between two platinum electrodes fused in through the sides. The electrical measurements were performed with the aid of d.c. circuits. Potential differences between probes were measured by compensation using a VTVM (Heathkit V-7A/UK) or an oscilloscope as a zero instrument. The value of the activation energy of electrical conductivity for nickel oxide was 13·7 kcal.

RESULTS AND DISCUSSION

Cyclohexanol was dehydrogenated to cyclohexanone and phenol over nickel oxide. In the vertical flow reactor system employed in the present study, cyclohexene was not detected in the catalysate, though Galwey[3] has reported its formation while examining the first stages in the reaction of cyclohexanol adsorbed on nickel oxide. The proportion of cyclohexanone and phenol in the catalysate at various temperatures is shown in Fig. 1. At all temperatures, a steady state of conversion was attained only after 40 minutes or so.

The mechanism of dehydrogenation of cyclohexanol below 370° C. appears to be different from that above 370° C. Below 370° C., the amount of unreacted cyclohexanol decreases with increasing temperature. Above 370° C., it shows an increase. On the other hand, cyclohexanone whose concentration in the catalysate increased upto 350° C., registers a fall above that temperature. Phenol follows a similar trend though the transition temperature is around 370° C. The apparent activation energy for the total decomposition of cyclohexanol, for the formation of cyclohexanone and phenol in the temperature range 300–350° C. are 11·3, 8·2 and 13·8 kcal/mole respectively.

---

* Present address: Laboratoire de Physico Chemie Minerale, 42, de Croylaan, 3030, Heverlee (Louvain), Belgium.

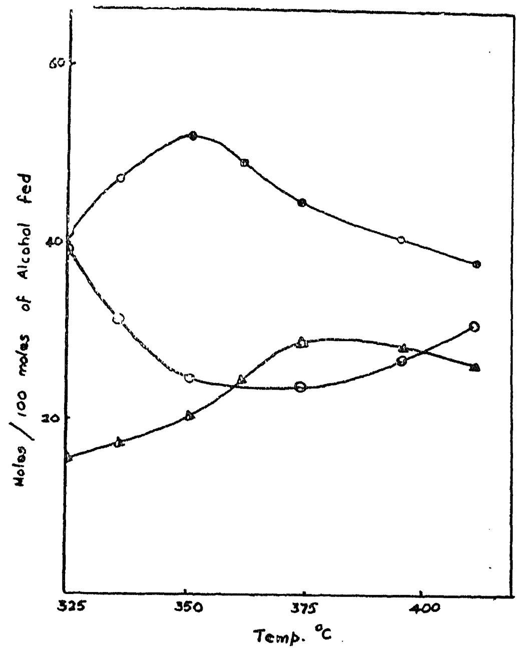


FIG. 1. Influence of temperature on the dehydrogenation of cyclohexanol over nickel oxide. $WHSV^{-1}$ = 1·0 hr. ○ Unreacted cyclohexanol ; ● Cyclohexanone ; △ Phenol.

The effect of contact time on the dehydrogenation of cyclohexanol has been studied at 350° C. and 410° C. The results are shown in Fig. 2. At 350° C., with increasing contact time, the amount of cyclohexanol undergoing reaction increases reaching a value of about 85 mole % at a contact time of 2 hr., with a corresponding increase in the amount of phenol formed. Cyclohexanone reaches its maximum value of 52 mole % at a contact time of 1·0 hr. and then decreases with further increase in contact time suggesting that the cyclohexanone initially formed undergoes further dehydrogenation to phenol. At 410° C., with increasing contact time, the amount of cyclohexanol undergoing reaction increases reaching a value of 73 mole % at a contact time of 2 hr. This is less than that got at 350° C. The amount of phenol at 410° C. is also less than that at 350° C. In the region of very low contact time, the rate of cyclohexanone formation is higher than the rate of formation of phenol. Since the maximum concentration of cyclohexanone is reached at 0·5 hr., while phenol reaches its maximum concentration only at a contact time of 2·0 hr., phenol should have been formed by the further dehydrogenation of cyclohexanone. From the values of initial rates, however, it may be inferred that phenol is formed simultaneously from either cyclohexanone or cyclohexanol.

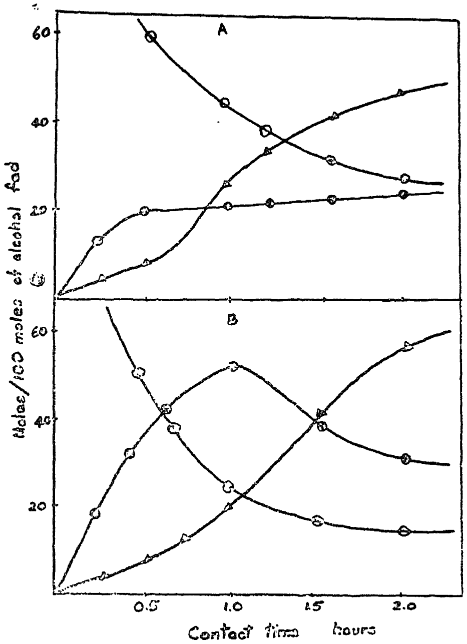


FIG. 2. Influence of contact time on the dehydrogenation of cyclohexanol over nickel oxide. A= 410° C. B=350 °C. ○ Unreacted cyclohexanol ; ● Cyclohexanone; △ Phenol.

The changes in the electrical conductivity of nickel oxide in the atmosphere of cyclohexanol are given in Fig. 3. Below 370° C., the conductivity decreases with time and finally attains a constant value. Above 370° C., there is an initial decrease in the conductivity followed by an increase. The log σ value increases above the initial conductivity to reach a constant value of conductivity. This value does not alter during the further course of the reaction. The electrical resistance was of the order of a few ohms in this region.

These results indicate that above 370° C., the catalyst is reduced to metallic nickel. The initial decrease in conductivity shows a surface reduction of Ni^{3+} to Ni^{2+}. The subsequent increase indicates a further reduction of Ni^{2+} to metallic nickel, the conductivity of which is of the order of a few mhos. Even at

380° C., it was observed that the conductivity of the sample decreased first and when the alcohol feed was stopped and oxygen-free nitrogen gas was let in at very low pressures, the desorption of the species brought about an increase in the conductivity which rose above the initial conductivity. This shows that a surface layer of metallic nickel begins to form at this temperature, in the course of the dehydrogenation of cyclohexanol. Such a case was not observed below 370° C.

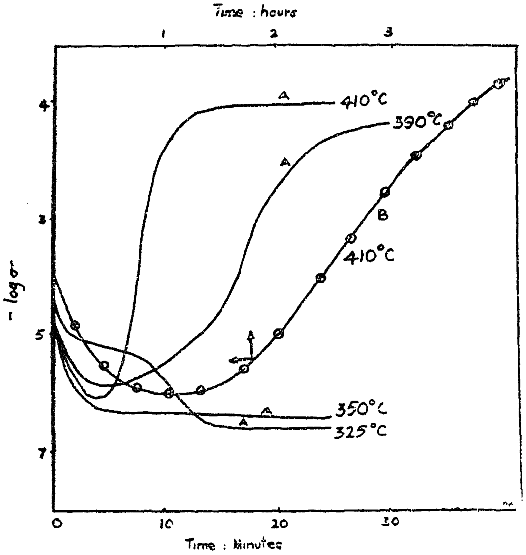


FIG. 3. Changes in the electrical conductivity of nickel oxide. A—In the atmosphere of cyclohexanol vapours; B—In the atmosphere of hydrogen.

The changes in conductivity of nickel oxide at 410° C. while passing dry hydrogen are also shown in Fig. 3. The conductivity decreases first and then increases, the process taking several hours to attain a constant value.

The effect of temperature on the dehydrogenation of cyclohexanol had already showed that above 380° C., the concentration of phenol goes down suggesting the possibility of phenol getting hydrogenated to cyclohexanol (Fig. 1). When phenol and cyclohexanol were mixed in 1 : 1 ratio and passed over the catalyst, the concentration of phenol was higher in the catalysate. In another series of experiments, phenol was mixed with isopropanol and passed over the catalyst at 410° C. If adsorbed hydrogen, liberated in the course of alcohol dehydrogenation, plays a part and is responsible for such hydrogenation activity, the nature of the catalyst at this temperature being identical, cyclohexanol should be formed. This was not observed.

Schuit and van Reijen[4] have successively applied hydrogen chemisorption to measure the surface area of the metallic part of nickel on carrier catalyst. In the present study, such adsorption isotherm studies were undertaken to follow the formation of metallic nickel on nickel oxide resulting from the dehydrogenation of cyclohexanol above 370° C. (Fig. 4).

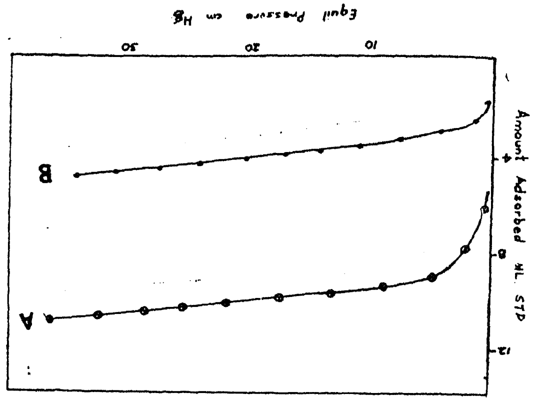


FIG. 4. Adsorption isotherms of hydrogen at 25 ° C. A: ○ Catalyst treated with cyclohexanol at 400 ° C. for an hour. B : ●—Catalyst reduced with hydrogen at 400° C. for 3 hours.

In the equilibrium pressure range of 30 to 600 mm. Hg., there was no adsorption of hydrogen on oxidised nickel oxide, the isotherm measurement being carried out at 25° C.

After each run of cyclohexanol dehydrogenation on oxidised nickel oxide at different temperatures, the catalyst was flushed with oxygen-free, dry nitrogen and the catalyst vessel was attached to the adsorption system, evacuated to 10^{-6} cm. Hg., and the hydrogen adsorption isotherms were measured at 25° C. For the catalysts treated upto 370° C., the amount of hydrogen adsorbed was found to be almost negligible, though the colour of the catalyst changed from greyish-black to yellowish-green. The latter observation shows that the chemisorbed excess oxygen on oxidised nickel oxide is desorbed completely by the adsorption of alcohol molecules in the dehydrogenation process.

Considerable amount of hydrogen was found to get adsorbed on the catalyst treated at 410° C. with vapours of cyclohexanol. In Fig. 4, isotherm A shows that the nature of the catalyst is similar to a metal-on-carrier type. The isotherm B is for the catalyst reduced at

400° C. for 3 hours. The similarity of the two curves further reinforces the fact that during the dehydrogenation reaction, the surface of nickel oxide is reduced to the metallic state. Thus starting from a pure metal oxide catalyst, a metal-on-metal oxide is obtained during the reaction. This means that the process of catalyst preparation cannot, strictly speaking, be considered as finished at the moment when the reaction starts. If one may so express it, the final preparation of the catalyst occurs in the process of reaction itself.

ACKNOWLEDGEMENT

Two of us (A. V. R. and P. R.) thank the CSIR, New Delhi, for Research Fellowships. The work was done in the Unit 'Chemisorption and Catalysis'.

---

1. Wolkenstein, F. F., in *The Electronic Theory of Catalysis on Semiconductors*, Pergamon Press, 1963, p. 5.
2. Boreskov, G. K. and Matveyev, K. I., *Problemy Kinetiki i Kataliza*, 1955, **8**, 165.
3. Galwey, A. K., *Proc. 3rd Intern. Congr. Catalysis*. Amsterdam, 1964, **1**, 49 (Pub. 1965)
4. Schuit, G. C. A. and van Reijen, L. L., *Advan. Catalysis*, 1958, **10**, 243.

SENSITIVITY TO GIBBERELLIC ACID IN RELATION TO DWARFING AND HARVEST INDEX IN BREAD WHEAT

B. BALDEV AND M. S. SWAMINATHAN

Division of Genetics, Indian Agricultural Research Institute, New Delhi-12, India

IT is well known that several genetic dwarfs in crop plants become tall when given an exogenous application of gibberellic acid (GA_3).[1] Allan and his co-workers[2] have studied the comparative response to GA_3 of dwarf, semi-dwarf and standard short and tall winter wheat varieties. They found that the dwarf and semi-dwarf varieties though responsive to applied GA_3 were not induced to grow to normal height, whereas standard-height varieties were stimulated significantly. All of these were winter varieties and GA_3 was applied after plants were exposed to low winter temperatures. The 'Norin' dwarfing genes introduced from Japan in wheat breeding programmes in the United States, Mexico and other countries after World War II have led to a major yield breakthrough in bread wheat by enabling the repatterning of the plant architecture in a manner suited for high levels of application of fertilizer and water.[3] The present study was undertaken to assess the reaction of wheat varieties possessing the 'Norin' dwarfing genes to the application of GA_3.

The following seven varieties were chosen for the study: two tall Indian varieties (C. 591 and N.P. 824) a γ-ray-induced dwarf mutant of N.P. 824, two semi-dwarf varieties developed in Mexico (Sonora 64 and Lerma Rojo), an experimental strain possessing 3 major genes for dwarfing (Triple dwarf) and an induced amber-grain mutant of Sonora 64 which was released for cultivation in India under the name Sharbati Sonora.[4] Monosomic analysis revealed that Lerma Rojo has a recessive gene for dwarfing in chromosome 6D and Sonora 64 and Sharbati Sonora have two such genes in chromosome 2A and 4D.[5] The triple dwarf had all the three genes with a reducing effect on height. An analysis of the pathway through which the varieties with 'Norin' dwarfing genes give high yields showed that besides being able to utilise more fertiliser because of the favourable morphological frame, they also had a better harvest index (*i.e.*, the ratio of grain to total dry matter, Table I).

TABLE I

Variety		Total dry matter yield (tonnes/hectare)	Harvest index
C. 591	..	10·30	0·29
N.P. 824	..	10·60	0·33
Dwarf mutant of N.P. 824		9·00	0·27
Lerma Rojo	..	11·00	0·50
Sonora 64	..	11·00	0·55
Sharbati Sonora	..	11·00	0·55
Triple dwarf	..	10·50	0·57

The procedure for assessing sensitivity to GA_3 was as follows: Grains were soaked on three layers of filter-paper in petri plates containing five ml distilled water. The seeds were so arranged that their grooved side faced the filter-paper. They were maintained at 15° C. inside an incubator for 48 hours by which time the coleoptile showed emergence.

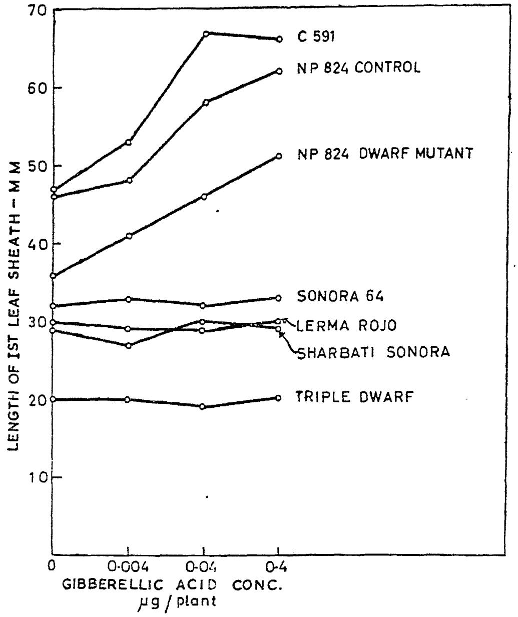


FIG. 1

Germinated seeds with a uniform length of coleoptile were selected and five such seeds were transferred to a flat bottom tube (3″ × 1″ dia.) three-fourth filled with 1% gelled agar and kept in continuous light at 25° C. In order to avoid drying up of these seeds, they were covered with a thin plastic sheet for another two days. By this time the root system was well established and seedlings were able to draw water from agar. At the end of this period, a 2μl drop of GA_3 solution prepared in 0·05% Tween-80 was applied to the tip of coleoptile. Five plants per treatment were used. The seedlings continued to grow in continuous light and distilled water was added as and when necessary to avoid desiccation of agar. As elongation of the first leaf-sheath stops after the emergence of the second leaf, the length of the first leaf-sheath was recorded at this stage. Depending upon the variety, this takes 5 to 6 days after GA_3 application. Three concentrations of GA_3, 0·004, 0·04 and 0·4 μg per plant were used. The seven varieties used could be broadly classified into two major groups as GA_3 sensitive and GA_3 insensitive (Fig. 1). The dwarf varieties possessing 'Norin' genes were not sensitive to the GA_3 amounts used in this study while the induced dwarf mutant of N.P. 824 responded to the treatment. The two tall varieties also responded to the treatment of gibberellic acid.

The induced dwarf of N.P. 824, which had been isolated in 1959 in the M_2 progenies of 16 Kr γ-ray-treated material, is not only about 20 cm. shorter in height than the parent, but has also more dense ears. Attempts to get high-yielding segregates from crosses involving this mutant have not so far been successful, in view of the pleiotropic association of plant height with ear density and spikelet number. The 'Norin' dwarfing genes, on the other hand, do not have such undesirable pleiotropic effects. It would be worthwhile examining all dwarfs of breeding value in crop plants for GA_3 sensitivity in order to ascertain whether generally dwarfs in which reduction in height is not due to a block in the endogenous synthesis of gibberellins are only capable of giving a high harvest index.

---

1. Brian, P. W. and Hemming, H. G., *Physiol. Plantarum*, 1955, **8**, 669.
2. Borlaug, N. E., *Proc. 3rd Int. Wheat Gen. Symp. Canbera*, 1968, p. 1.
3. Allan, R. E., Vogel, O. A. and Craddock, J. C. Jr., *Agron. J.*, 1959, **51**, 737.
4. Varughese, G. and Swaminathan, M. S., *Indian Fmg.*, 1967, **17**, 8.
5. Jha, M. P. and Swaminathan, M. S., *Curr. Sci.*, 1969, **38**, 379.

LETTERS TO THE EDITOR

POSSIBLE METHOD OF LIQUID METAL POWER CONVERSION SYSTEM

Abstract

A system is proposed by which liquid metal piston columns, obtained by pumping the metal before a nozzle, are driven by high velocity vapours from the nozzle. End effects are avoided. The EMF is tapped off from the moving liquid column by electrodes through a transformer.

In the magneto hydrodynamic process use of liquid metals have advantage over gases especially at lower temperatures. No energy has to be expended to impart conductivity by ionisation, as in the case of gases. Several methods have been suggested for imparting high velocities to liquids and for maintaining continuity of conductivity in the generating section.[1-4]

In the proposed system, small columns of liquid metal are placed before a nozzle, by a pump. Enough liquid is pumped in columns each time, so as to block the flow-channel. The column then acts as a piston and is driven by the high velocity vapours from the nozzle.

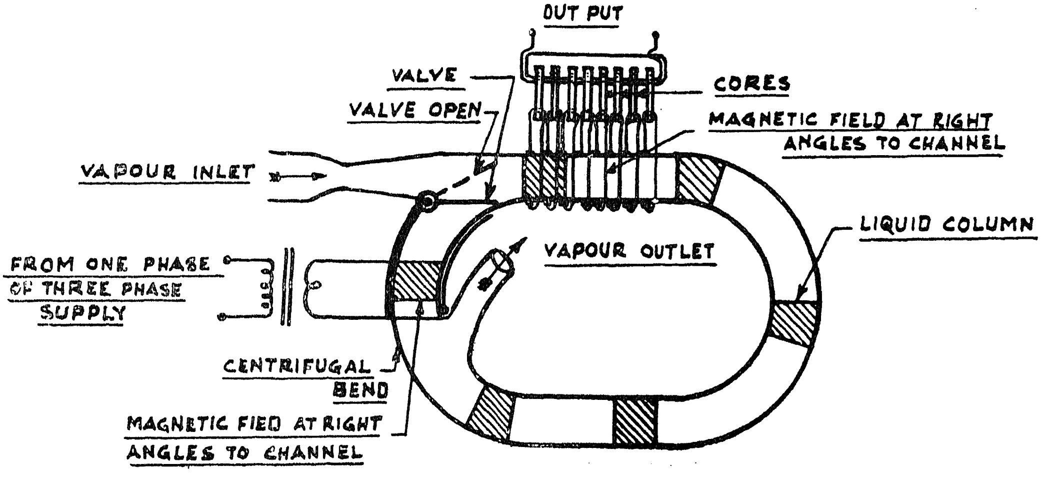

OUT PUT
VALVE
VALVE OPEN
CORES
MAGNETIC FIELD AT RIGHT ANGLES TO CHANNEL
VAPOUR INLET
LIQUID COLUMN
VAPOUR OUTLET
FROM ONE PHASE OF THREE PHASE SUPPLY
CENTRIFUGAL BEND
MAGNETIC FIED AT RIGHT ANGLES TO CHANNEL

FIG. 1. Schematic diagram of the generator system.

Figure 1 schematically shows the arrangement with a single nozzle. The liquid metal, as it arrives at the centrifugal bend with remnant kinetic energy after having circulated in the generator loop, is imparted further energy by the electromagnetic pump, to open the flap valve and to be replaced before the nozzle. The remnant kinetic energy of the column is therefore not wasted. Even if the liquid is in a continuous mass in the pump the amount pumped in the column depends upon the pressure difference in the pump and the nozzle. Since the flow is in discontinuous columns there are no losses due to end effects in the system. The centrifugal bend separates the liquid and the vapour which is sent back to the boiler. Suitably positioned sensors sense any condensed vapours in the liquid loop and any liquid metal driven to the condenser, and pump them back to their respective loops. The system could be a single or a two-fluid system.

If b is the smaller dimension of the cross-section of the channel, the difference in pressure on either side of the liquid column beyond which the gas will pierce the column as bubbles is given by $4T/b$ where T is the surface tension of the liquid. Under the magnetic field in the generating section the liquid will attain additional stiffness. Assuming a cylindrical column moving ahead of the bubble, and the emf. in this column short-circuited by the rest of the liquid, the additional pressure difference required is $8/3\pi B^2 b v \sigma$ where B is magnetic field in the liquid, σ the electrical conductivity of the liquid and v is the velocity of the bubble in the liquid column.

The advantages of this system are that there are no losses due to end effects, the transfer of energy from the vapour to the piston formed by the column of liquid is more efficient, the remnant velocity of the liquid is not wasted and hermetically sealed systems are easily possible.

In preliminary experiments, mercury was used as the liquid metal and nitrogen was used as the driving gas. The electromagnetic pump worked effectively when a heavy current was passed through the liquid through conducting segments on either side of the channel, from one phase of a three-phase supply and the magnet at right angles to the current fed from the next lagging phase. The current and flux being almost in phase produced a high pressure on the liquid. In the generating section a large number of small conducting segments were placed both across and along the channel and each opposite pair of segments were connected to separate primaries mounted on separate cores of a transformer, of which the secondary linked all the cores. The magnetic field in the generating section was an a.c. field. This arrangement enabled the generated low voltage power to be tapped off at a high voltage.

Thanks are due to K. V. Balakrishnan for fabrication of some parts of the test system and to A. S. Rao, Director, Electronics Group, for the facilities used.

Electronics Division, P. R. DASTIDAR.
Bhabha Atomic Res. Centre, K. RAVINDRAN.
Trombay, Bombay-85,
February 25, 1970.

---

1. Elliot, D. G., *ARS Journal*, June 1962, p. 924.
2. Petrick, M., "Electricity from MHD," *Proc. Symp. Salzburg, IAEA*, Vienna, 1966, **2**, 889.
3. Bidard, R. and Steline, J., *Ibid.*, p. 1077.
4. Brown, G. A. and Levy, E. K., *Ibid.*, p. 1091.

REDUCTION OF SULPHATE BY SULPHUR IN VACUUM

IT has been reported[1] that sulphur reacts with oxides of heavy metals, in vacuum, to form a sulphur rich oxide along with sulphur dioxide. It is now observed that sulphur reacts with metallic sulphates under similar conditions to give the lower oxides of sulphur.

A mixture of sulphur and anhydrous copper sulphate when heated at 300–450° C. in vacuum gives out a mixture of a sulphur-rich oxide and sulphur dioxide. The gaseous products of the reaction can be condensed in a trap cooled in liquid oxygen (–184° C.). The condensate is cherry red to orange-red in colour. The analysis of this condensate by methods already reported[2] indicates that it is a mixture of sulphur dioxide and disulphur monoxide.

The sulphur to oxygen ratio of the condensate varies from 1 : 1·5 to 1 : 1. The yield of the sulphur-rich oxide depends on experimental conditions reaching a maximum of 50 mole % of the condensate. Cupric sulphide is the other product.

Similar results are obtained when anhydrous sulphates of the transition series metals and other heavy metals like lead are heated with sulphur in vacuum. The temperature and the yield of disulphur monoxide vary in these cases.

Sulphates of alkali and alkaline earth metals and aluminium give sulphur dioxide only. The other products are metallic oxides in these cases.

These observations clearly indicate that the reduction of sulphates by sulphur is a general reaction. Detailed experimental results will be published shortly.

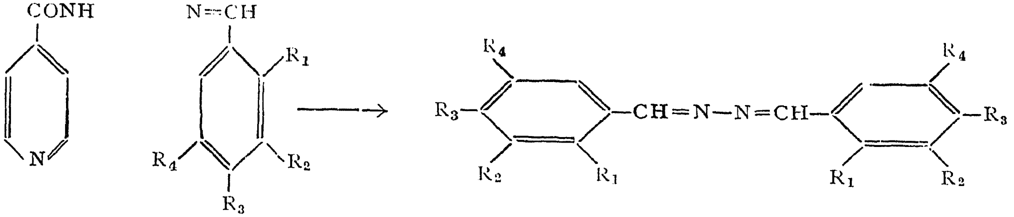
Dept. of Inorganic K. RAVINDRAN NAIR.
and Phys. Chem., T. R. NARAYANAN KUTTY.
Ind. Inst. of Sci., A. R. VASUDEVA MURTHY.
Bangalore-12, *May* 2, 1970.

---

1. Vasudeva Murthy, A. R., *Nature (London)*, 1962, **193**, 773.
2. —, *Proc. Ind. Acad. Sci.*, 1952, **36**, 425.

AN INTERESTING OBSERVATION ON THE REACTION OF SCHIFF'S BASES FROM ISONIAZIDE

IN connection with a project on the syntheses of amino compounds with a possible therapeutic value, we prepared a number of new Schiff's bases by the condensation of isoniazide with different aromatic aldehydes. Whilst some of the Schiff's bases were found to show appreciable antituberculous activity,[1] our chief interest was to obtain the corresponding amino derivatives from the Schiff's bases by reduction. A convenient method for this purpose which also gives high yields of the amines has been described by Takeshima *et al.*,[2] which involves the reduction of Schiff's bases with aluminium amalgam in alcohol at room temperature followed by the decomposition of the reaction mixture with cold aqueous (10–25%) sodium hydroxide. When this method was applied to the Schiff's base (I), a compound $C_{14}H_{12}N_2$ (Mol. Wt. 208, mass spectrum), m.p. 93° was isolated in about 50% yield. From the analytical and spectral pro-



I. $R_1=R_2=R_3=R_4=H$; m.p.[3] 93°.
II. $R_1=R_2=R_4=H$; $R_3=OCH_3$; m.p.[4] 178°.
III. $R_1=R_4=CH_3$; $R_3=OC_2H_5$; $R_2=H$; m.p. 235–36°.
IV. $R_1=H$; $R_3=OC_2H_5$; $R_2=R_4=CH_3$; m.p. 155–56°.

perties (u.v., i.r. and n.m.r.), it was identified and confirmed as benzalazine (m.m.p.). The latter obviously results from the decomposition (NH_3 being evolved during the reaction) of the Schiff's base into isonicotinic acid, hydrazine and benzaldehyde. The last two compounds react together in the presence of alkali to give benzalazine. It was, therefore, of interest to see if in the formation of the latter compound, aluminium amalgam had taken any part. We, therefore, carried out the reduction of the Schiff's base (I) with aluminium amalgam and decomposed the reaction mixture with water and aqueous potassium carbonate in two different experiments. In both the cases, however, the original Schiff's base was recovered unchanged. The formation of benzalazine was, therefore, obviously due to the action of aqueous sodium hydroxide. This observation was supported by the fact that the Schiff's base (I) on keeping with aqueous sodium hydroxide for 30 minutes, at room temperature, yielded benzalazine in 50% yield. At a higher temperature, almost the whole of the Schiff's base was converted into benzalazine with aqueous sodium hydroxide.

This reaction is a general one and the azine derivatives I to IV have been prepared from the corresponding Schiff's bases, by treatment with cold aqueous alkali.

Institute of Science,
15, Madam Cama Road,
Bombay-32, *March* 9, 1970.

J. R. Merchant.
D. S. Chothia.

---

1. Merchant, J. R. and Chothia, D. S., *J. Med. Chem.* 1970, **13** (2), 335.
2. Takeshima, T., Muraoka, M., Asaba, H. and Yokoyana, M., *Bull. Chem. Soc. Japan*, 1968, **41** (2), 506.
3. (*a*) Curtius, Th. and Jay, R., *J. prakt. Chem.*, 1889, **39**, 44.
(*b*) Thiele, Von J., *Ann.*, 1910, **376**, 244.
4. Borsche, W., *Ber.*, 1921, **54 B**, 660.

A NOTE ON THE COLOUR CHANGE OF THE FLOWERS OF *HIBISCUS MUTABILIS*

Hibiscus mutabilis[1] (Family : *Malvaceæ*), commonly known as "changing rose", is grown as an ornamental plant for its large flowers which change colour from ivory-white in the morning to light rose by noon and pink-red in the evening. Based on a preliminary study of its flavonoids, the flower petals have been recorded[2] to contain quercimeritrin, meratin and cyanin. With a view to understanding the chemistry of the sequence in the colour change, a detailed examination of the flowers of this plant has been undertaken and the results are recorded in brief :

Fresh flowers (1 kg.) were collected from the plants at about 8 a.m., 12 Noon and 4 p.m. and separately worked up for the flavone and anthocyanin pigments by conventional method adopted in our laboratories.[3,4] The 8 a.m. batch contained no anthocyanin at all, and the flavonol glycosides (0·2 g.) were identified as isoquercitrin, hyperoside, rutin and quercetin-4′-glucoside in addition to quercimeritrin recorded earlier[2] by two-dimensional paper chromatography and comparison with authentic samples; the free aglycone was identified as quercetin.

The flowers of the 4 p.m. batch contained the maximum concentration of anthocyanins and the pigments were identified to be cyanin (cyanidin-3 : 5-diglucoside) and cyanidin-3-rutinoside-5-glucoside with cyanidin as the free aglycone. The same anthocyanins were present in the flowers of the 12 Noon batch, but the concentration was only one-third. The flavonols of the 12 Noon and 4 p.m. flowers were identical with those of the morning batch both qualitatively and quantitatively and no reduction in the flavonol content was noticed indicating the non-utilization of the flavonol for anthocyanin synthesis. The change of colour from ivory-white to pink-red through light rose is, therefore, attributable to the absence of the anthocyanin in the morning and the progressive development of the colour due to anthocyanin synthesis as the day passes and its masking the ivory-white colour (due to flavonols) as suggested by Harborne,[5] the concentration of the anthocyanins reaching the maximum quantity by the evening. Both the five-petalled and the multi-petalled varieties had the same flavonoid pattern.

The colour change of the petals has also been observed, in the laboratory, to take place in the case of flowers plucked out of the plants and kept moist at the room temperature as under hydroponic conditions. In such cases, a temperature range of 10 to 40° C. and pH 5 to 9 have been found to be favourable for the anthocyanin synthesis and outside these ranges the morning colour remains almost unchanged.

Dept. of Chemistry, S. SANKARA SUBRAMANIAN.
J.I.P.M.E.R., A. G. R. NAIR.
Pondicherry-6, *February* 3, 1970.

1. Bor, N. L. and Raizada, M. B., *Some Beautiful Indian Climbers and Shrubs*, The Bombay Natural History Society, Bombay, 1954, p. 234.
2. Subramanian, S. S. and Swamy, M. N., *Curr. Sci.*, 1964, **33**, 112.
3. Nair, A. G. R., Nagarajan, S. and Subramanian, S. S., *Ibid.*, 1964, **33**, 431.
4. Harborne, J. B., *Comparative Biochemitry of Flavonoids*, Academic Press, 1967.
5. —, In *Chemistry and Biochemistry of Plant Pigments*. Ed. Goodwin, T. W., Academic Press, 1965, p. 266.

[*Note by Referee:* The anthocyanins are not the floral pigments: Vide, *Current Science*, 1969, **38**, 179 & 451.]

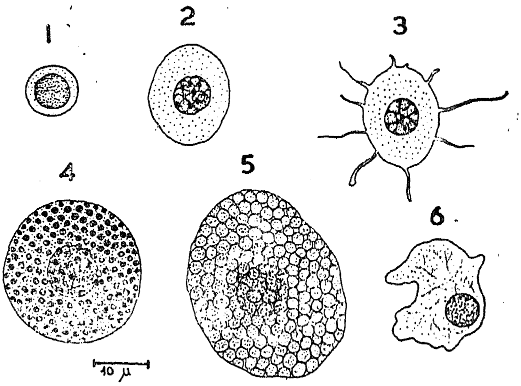
A STUDY OF HAEMOCYTES OF A CENTIPEDE *ETHMOSTIGMUS SPINOSUS* (CHILOPODA : MYRIAPODA)

BUCHERL[1] AND GREGOIRE[2] described two kinds of hæmocytes, amœbocytes and hyaline cells, in *Scolopendra viridicornis* and *Lithobius forficatus*. In addition to these, a third type known as lymphocytes was described from *Scolopendra morsitans*.[3] These authors have taken into consideration the shape of the cells and the presence or absence of granules in the cytoplasm as basis for classification of hæmocytes in these centipedes. In the light of recent observations of Jones[4] and Sundara Rajulu *et al.*,[5] the criteria applied by workers on centipede hæmocytes is of little importance as the characters taken into consideration by these authors are found in more than one type of hæmocytes and are known to be variable in the same hæmocyte during different growth stages.[3] It is therefore felt that a study of the hæmocytes in centipedes in the light of recent observations would be of interest.

The centipedes of the species *Ethmostigmus spinosus*, collected from Alagarkoil Hill region, were the materials used. The methods of collection of hæmolymph and preparation of smears and the stains employed were the same as given elsewhere.[5] The hæmocytes were examined with phase contrast microscope and classified using the nomenclature suggested by Jones.[4]

Five types of hæmocytes are distinguishable from the blood of *Ethmostigmus spinosus*.

Type 1.—These are round cells appearing pale gray and homogeneous (Fig. 1). They measure 5 to 7 µ in diameter. The nucleus is round and occupies nearly the entire cell, leaving only a thin band of peripheral cytoplasm. The nucleus shows evenly distributed chromatin granules. These hæmocytes recall the prohæmocytes of insects.[6]



FIGS. 1–6. Hæmocytes of *Ethmostigmus spinosus*
Fig. 1. A prohæmocyte. Fig. 2. A normal plasmatocyte.
Fig. 3. A plasmatocyte with thread-like pseudopodia.
Fig. 4. A granular hæmocyte. Fig 5. A spherule cell.
Fig. 6. An œnocytoid.

Type 2.—The hæmocytes of the second type are characterized by their morphological variability. They measured from 15 to 20 µ in diameter. The common variety was ovoid with a large centrally placed nucleus containing many chromatin granules (Fig. 2). The cytoplasm is devoid of any inclusions. In fresh preparations, a few of this type of cells send out minute, thread-like pseudopodia (Fig. 3). These cells ingest indigo carmine particles injected into the blood. These characters would relate this type of hæmocytes to the plasmatocytes of insects.[4]

Type 3.—These hæmocytes are round cells measuring 25 to 30 μ in diameter. They are filled with numerous discrete round granules (Fig. 4). The granules often mask the centrally placed small nucleus. In unfixed toluidine blue-stained preparations, the granules stain pink and the cytoplasm blue, while the nucleus stains pale red. When left unfixed, these cells degenerate within 10 to 12 minutes, ejecting the granules. The ejected granules remain intact for more than 30 minutes.

These cells actively ingest carmine particles injected into the blood; therefore, these hæmocytes strongly recall the granular hæmocytes of insects.[7]

Type 4.—These are the largest hæmocytes of oval shape measuring 48 to 52 μ in diameter. They contain several large spheroid inclusions which fill up the whole cell (Fig. 5). The nucleus is centrally placed and is often obscured by the spherules. These are very unstable cells; often they rupture releasing the spherules which disintegrate quickly. Phagocytosis was not observed in these cells. These characters may relate this type of hæmocytes to the spherule cells of insects.[8]

Type 5.—These are ovoid or irregularly shaped hæmocytes, measuring 20 to 22 μ in diameter. The nucleus is characteristically eccentric (Fig. 6). The cytoplasm contains fine granular network. These cells exhibit amœboid movements in fresh preparations. These features recall those of the œnocytoids of insects.[9]

The foregoing observations may indicate that there is close resemblance between the hæmocytes of the centipede and those of insects. However, cystocytes which are commonly seen in inects[4] are not found in the centipede. The amœboid hæmocytes described from *Scolopendra viridicornis*[1] may correspond to the plasmatocytes with hyaloplasmic extensions and hyaline cells from *Lithobius forficatus*[2] to the granular hæmocytes while the lymphocytes from *Scolopendra morsitans*[3] may correspond to the prohæmocytes of *Ethmostigmus spinosus*.

I am grateful to Professor G. Krishnan, Director, for his interest in this study and provision of facilities. The technical assistance rendered by Dr. N. Krishnan is much appreciated.

Dept. of Zoology, G. Sundara Rajulu.
University of Madras,
Madras-5, *February* 3, 1970.

---

1. Bucherl, W., *Mem. Inst. Butanton*, 1939, **13**, **49**.
2. Gregoire, C., *Arch. Biol.*, 1955, **66**, 489.
3. Shukla, G. S., *Agra Univ. J. Res. (Science)*, 1964, **13**, 227.
4. Jones, J. C., *Am. Zoologist*, 1962, **2**, 209.
5. Sundara Rajulu, G., Krishnan, N. and Manmohan Singh, *Zool. Anz.*, 1969 (In press).
6. Yeager, J. F., *J. Agr. Res.*, 1945, **71**, 1.
7. Jones, J. C., *J. Morph.*, 1956, **99**, 233.
8. McLaughlin, R. E. and Allen, G., *Biol. Bull*, 1965, **128**, 112.
9. Rizki, M. T. M. and Rizki, R. M., *J. Biophys. Biochem. Cytol.*, 1959, **5**, 235.

IDENTITY OF THE THREE HETEROPHYID METACERCARIAE INFESTING SOME OF THE FRESHWATER FISHES

Heterophyid flukes widely distributed in fish-eating vertebrates constitute an important group of intestinal parasites. Some of the species have a zoonotic significance.[12] Life-cycle studies, undertaken with some of the representatives of *Heterophyes* Cobbold, 1886; *Heterophyopsis* Tubangui *et* Africa, 1938; *Centrocestus* Looss, 1899; *Haplorchis* Looss, 1899; *Procerovum* Onji *et* Nishio, 1916; *Metagonimus* Katsurada, 1913; *Stellantchasmus* Onji *et* Nishio, 1915; *Stictodora* Looss, 1899; *Apophallus* Lühe, 1909; *Pygidiopsis* Looss, 1907, have revealed a number of freshwater fishes as second intermediaries. In view of the rôle in helminthic zoonosis, observations on infectivity, development, maturity and recovery rates of important species, like *M. yokogawai* (Katsurada, 1912) Katsurada, 1913, in hamsters, cotton-rats, guinea-pigs and mice, orally infected with the metacercariæ, have been reported.[13]

In addition to the occurrence, in dogs and cats, of *Heterophyes heterophyes* (Siebold, 1852) Stiles *et* Hassall, 1900 and *Stictodora manilensis* Africa *et* Garcia, 1935, in dogs,[6] the earlier reports on *Haplorchis taichui* (Nishigori, 1924) and *H. yokogawai* (Katsuta, 1932) and their hosts, domestic and wild, have been referred by Gupta *et* Pande,[2] Simha *et* Deshpande,[11] Sahasrabudhe *et* Shah,[8] Sahasrabudhe *et al.*,[9] Prakash *et* Pande[5] and Sahai.[7] *H. vagabundi* Baugh, 1963[1] and *H. gyanpuri* Jain, 1968[3] are described from birds, *Dendrocitta vagabunda* and *Milvus migrans* respectively. *Dryophis mycœrizans*, a green tree-snake, has been named to harbour *H. solus*.[10]

In spite of the prevalence of the adult heterophyids in some of our animals, metacercaria of *Haplorchis yokogawai* is alone known from *Puntius ticto* (Hamilton) and *Mystus vittatus* (Hamilton).[4] Continuing our search for the diverse metacercarial forms infesting some of the freshwater fishes, numerous specimens of *Cirrhina reba, Amblypharyngodon mola, Labeo bata* and *Puntius* sp., available at Keetham lake (39 km. away from Mathura), yielded two types of metacercariæ referable to *Haplorchis* and another kind to *Centrocestus*. Haplorchine metacercariæ occurred as minute oval or spherical bodies in the pectoral, dorsal and caudal fins and in the gill filaments of *C. reba* and *A. mola*. The ovoid form, 160–208 μ × 125–138 μ in size, had a thin cyst wall of 1·5–2 μ thickness. In the spherical type, 203–242 μ in diameter, the thicker cystic wall was in two layers—an inner of 2–2·5 μ and the outer of 29–58 μ in thickness. Differential pattern of the armature in the ventrogenital sac enabled an identification of the former as belonging to *H. yokogawai* and the latter representing *H. taichui*. The third form, also transparent like *H. yokogawai*, was ovoidal in outline and, with 136–203 μ × 106–135 μ in size, had a 1·5–2 μ thick cystic wall. It, however, occurred exclusively in the gill region of all the four species. The two rows of the circumoral spines, the X-shaped feature of excretory bladder and the topography of the gonads aided in its generic classification.

Feeding of the haplorchine cysts to 2 albino-rats, 2 pups and 1 pigeon yielded, at autopsy, the adult specimens of *H. yokogawai* and *H. taichui*. From administration of metacercarial cysts of *Centrocestus* to 4 albino-rats, 1 guinea-pig, 3 pups, 1 white leghorn cockerel and 1 pigeon, mature flukes referable to *C. formosanus* (Nishigori, 1924) were recovered at autopsy. The recovery rate, in both these experiments, varied considerably.

The present note records the discovery of the Indian species of the second intermediate hosts involved in transmission of the three species which have been incriminated in zoonosis. The recovery of the adults of *Centrocestus formosanus*, during experimental studies, is a first report of this genus in India. It appears surprising that the infective stage of this fluke became known before its adult.

Grateful acknowledgement is due to the Indian Council of Agricultural Research for the award of a Senior Research Fellowship to one of us (D. N.). Thanks are due to the Principal of the College for the facilities provided.

Dept. of Parasitology, DHARMENDRA NATH.
U.P. College of Veterinary B. P. PANDE.
Science and Animal Husbandry,
Mathura, *February*-2, 1970.

---

1. Baugh, S. C., *Z. f. Parasitenk*, 1963, **22**, 303.
2. Gupta, V. P. and Pande, B. P., *Agra Univ. J. Res. (Sci.)*, 1964, **13**, **161**.
3. Jain, S. P., *Indian J. Helm.*, 1967, **19**, **150**.
4. Pande, K. C., *Proc. Nat. Acad. Sci. (Section B)*, **1966**, **36**, **437**.
5. Prakasn, R. and Pande, B. P., *Indian J. Helm.*, 1968, **20**, 1.
6. Rao, B. V. and Anantaraman, M., *J. Helm.*, 1967, **41**, **211**.
7. Sahai, B. N., *Curr. Sci.*, 1970, **39**, **13**.
8. Sahasrabudhe, V. K. and Shah, H. L., *Indian J. Helm.*, 1967, **19**, 56.
9. —, Dubey, J. P. and Srivastav, H. O. P., *Indian J. Med. Res.*, 1969, **57**, 56.
10. Simha, S. S., *Rev. Biol. Trop.* (Costa Rica), 1964, **12**, 1.
11. — and Deshpande, P., *J. Osmania Univ. Science*, 1964, **1**, 53.
12. Sprent, J. F. A., *Helm. Abstr.*, 1969. **38**, **333**.
13. Yokogawa, M. and Sano, M., *Japanese J. Parasit.* (English abstract), 1968, **17**, 540.

EFFECT OF LACTIC ACID AND KALLIKREIN ON VASCULAR PERMEABILITY IN THE SHEEP

IT has been suggested that the accumulation of granulocytes in tissues may increase vascular permeability indirectly by producing lactic acid.[1] The association of the delayed increase in vascular permeability in the sheep, with the large-scale leucocytic emigration,[2] raises the possibility of granulocytes contributing to the increased permeability indirectly, by the lactic acid they may produce. Since lactic acid has been shown to cause vasodilatation in the guinea-pig skin,[1] its effect on vascular permeability in the sheep skin was tested.

Kallikrein has been shown to be an enzyme—an endogenous protease. It exists in an inactive from in the blood. On activation following injury, it liberates a kinin that is capable of producing increased vascular permeability.[3] Intradermal injection of kallikrein in the rat has been found to increase vascular permeability; this is presumed to be due to the formation of kinins in the skin.[4] There is a growing body of evidence in the rat[5] and the guinea-pig[3] which suggests that kallikrein may be involved in the mediation of the delayed permeability response during an acute inflammatory reaction. Its similar role was investigated in the sheep.

Romney × Cheviot lambs, of either sex, weighing about 20 kg. and 6–10 months of age were used. Lactic acid and kallikrein were tested in the sheep for their ability to increase vascular permeability to circulating pontamine blue, as described by Lancaster and Vegad.[6] A 4%, 2% and 1% solution of lactic acid (v/v) was prepared in saline and injected intradermally in a standard volume of 0·1 ml., the pH for each strength being 1·88, 1·90 and 1·97 respectively, as checked on a Beckman pH meter. In all strengths, 0·1 ml. of lactic acid injected intradermally induced leakage of dye that appeared within 1–3 min. after the injections. Maximal effects were observed with the 4% solution: 2% and 1% solution appeared to be of the same order of effectiveness. Kallikrein (Glumorin; Bayer Ltd.) was injected in amounts of 1 and 2 biological units. Kallikrein caused marked leakage of dye. The blueing appeared after a latent period of about 4 minutes. There was a distinctly greater response in the larger dose in that a more intense blueing developed.

The antihistamine mepyramine maleate (Anthisan; May and Baker Ltd.) was used to try to suppress the increased vascular permeability caused by lactic acid and kallikrein. Mepyramine was injected intramuscularly in a single dose of 25 mg./kg. 15 min. before the intradermal injections of lactic acid and kallikrein, in the percentages and doses referred to above. It was found that mepyramine-pretreatment failed to suppress the leakage of dye at all sites where lactic acid was injected. With kallikrein, however, the leakage of dye was delayed for about 15 min. Blueing then increased gradually until at 30 minutes the intensity of colour was similar to that produced in untreated animals.

The results show that lactic acid increases vascular permeability in the sheep. However, recent work by Logan and Wilhelm[7] indicates that the delayed permeability response to ultraviolet injury in the guinea-pig, rat and rabbit is independent of tissue leucocytosis, upon which the production of lactic acid is depended. Thus, the possibility of a causal relationship between leucocytosis, and the delayed increase in vascular permeability in the sheep, remains to be further investigated.

The failure of mepyramine maleate to suppress the increased vascular permeability, induced by kallikrein, indicates that the permeability response induced by it is not dependent on the release of histamine. However, the brief delay in the leakage of dye noticed in the early stages, after mepyramine-pretreatment, does point to some histamine release by kallikrein. This contrasts with the results obtained in the rat.[8] Furthermore, the slightly longer period of 3–4 min. after which an increase in vascular permeability was noticeable with kallikrein, and the gradual increase thereafter differs from the results of histamine, 5-hydroxytryptamine and bradykinin.[2] Kallikrein is a kinin-forming enzyme present in plasma. Bhoola *et al.*[4] suggested that increased permeability caused by the injection of kallikrein into the rat skin is, presumably, due to the formation of kinins *in vivo*. This may explain the present results obtained in the sheep and could account for the slightly longer period noticed with kallikrein, because of the time needed for the formation of kinins in the skin.

This work was carried out under a Commonwealth Scholarship and a research grant awarded by the University Grants Committee of New Zealand. I would like to thank Prof. M. C. Lancaster, then Professor of Animal Health at Massey University, for his help and advice.

Dept. of Animal Health, J. L. VEGAD.
Massey University, Palmerston North,
New Zealand, *January* 13, 1970.

---

* Present address: Department of Medicine, Veterinary College, Jabalpur (M.P.).

1. Miles, A. A., *Fedn. Proc. Fedn. Am. Socs. exp. Biol.* (Suppl. 9), 1961, **20**, 141.
2. Vegad, J. L., *Ph.D. Thesis*, Massey University, New Zealand, 1967.
3. Wilhelm, D. L., In *The Inflammatory Process* (B. W. Zweifach, L. Grant and R. T. McCluskey, eds.), Academic Press, Inc., New York, 1965, p. 389.
4. Bhoola, K. O., Calle, J. D. and Schachter, M., *J. Physiol.*, 1960, **152**, 75.
5. Spector, W. G. and Willoughby, D. A., *Bact. Rev.*, 1963, **27**, 117.
6. Lancaster, M. C. and Vegad, J. L., *Nature, Lond.*, 1967, **213**, 840.
7. Logan, G. and Wilhelm, D. L., *Br. J. exp. Path.*, 1966, **47**, 286.
8. Spector, W. G. and Willoughby, D. A., *J. Path. Bact.*, 1963, **86**, 487.

ANTIBIOTIC PROPERTY OF A MARINE INTERSTITIAL BACTERIUM

It has been well established that sand grains harbour many micro-organisms on their surface and that they influence the various activities of the surrounding meiofauna.[1,2] Recently, Anderson and Meadows[3] studied the bacterial population on the surface of marine sand grains in the intertidal area. During the routine estimation of microbial population in the interstitial water at Porto Novo open beach the authors observed that some bacterial colonies showed antibacterial and antifungal properties. Such colonies were isolated, purified and tested for their antibiotic property under laboratory conditions.

Different staining and biochemical tests showed that they belong to *Bacillus* sp. The antibiotic was isolated by the modified method of Chandramohan and Mahadevan.[4] The culture was grown in liquid nutrient broth for three days with eight-hour shaking per day at room temperature (26 ± 2° C.) The broth was filtered through Millipore filter using Whatman No. 42 filter-paper and the cell-free culture filtrate (pH 5·4) was adjusted to pH 4·0 with 1 N HCl and extracted three times with ether (Fraction 1). The same filtrate was again adjusted to pH 10·0 with 1 N NaOH and similarly extracted with ether (Fraction 2). The bacterial cells were washed several times with sterile glass-distilled water and ground in a glass mortar with acid-washed quartz and extracted with ether (Fraction 3). The ether fractions were evaporated separately under reduced pressure and each residue was dissolved in 2 ml. of ethanol. 150 μl. of the extract were spotted on standard antibiotic disc (S 740 E) and assayed against test cultures.

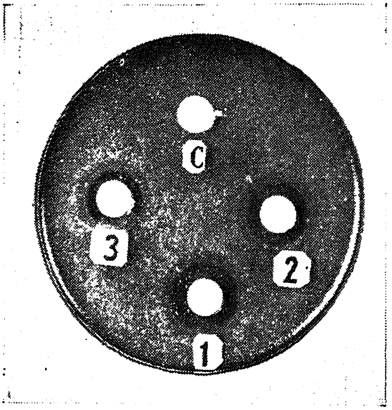


FIG. 1. Inhibition area caused by various fractions.

The antibiotic showed good inhibition of another *Bacillus* sp. isolated in the same area. Even though all the fractions had antibacterial property, fraction 1 showed highest inhibition followed by fractions 2 and 3. The area of inhibition is expressed according to scheme of Smale and Keil[5] and shown in Fig. 1 and Table I. In addition to this the fractions were tested against *Xanthomonas* sp. (gram negative), *Saccharomyces* sp. (yeast) and *Aspergillus* sp. (fungus). The various fractions were not active against gram negative and yeast but inhibited markedly the fungus. It is evident that the antibiotic reported here has both antibacterial and antifungal properties. In spite of earlier reports[6] about few antibiotics from *Bacillus* sp., this seems quite interesting under marine environments.

TABLE I

Antibiotic activity against Bacillus *sp.*

Sample		Quantity of culture filtrate used (ml.)	Dry weight of bacterial cells (mg.)	Area of inhibition (mm.^{2})
Fraction 1	..	100·00	..	459·64
,, 2	..	100·00	..	201·14
,, 3	..	..	56·20	170·50

We thank Prof. R. V. Seshaiya, Director, UGC Centre of Advanced Study in Marine Biology, Porto Novo, for guidance and critical reading of the manuscript.

Centre of Advanced K. AYYAKKANNU.
Study in Marine Biology, D. CHANDRAMOHAN.
Marine Biological Station,
Porto Novo, S. India, *March* 14, 1970.

---

1. Wilson, D. P., *J. mar. biol. Ass. U. K.*, 1955, **34**, 531.
2. Gray, J. S., *J. exp. mar. Biol. Ecol.*, 1967, **1**, 47.
3. Anderson, J. G. and Meadows, P. S., *Hydrobiologia*. 1969, **33**, 33.
4. Chandramohan, D. and Mahadevan, A., *Experientia*, 1968, **24**, 427.
5. Smale, B. C. and Keil, H. L., *Phytochemistry*, 1966, **5**, 113.
6. Bread, R. S., Murray, E. G. D. and Smith, N. R., *Bergey's Manual of Determinative Bacteriology*, The Williams & Wilkins Co., 1957.

PEAT-BASED LEGUME INOCULANT EXPERIMENTS WITH SOYBEAN

PEAT AND SOIL are used widely as carriers for *Rhizobium* spp. In this country soil based cultures fortified with sucrose (1%), K_2HPO_4 (0·05%) and lime (3%) have been in vogue and only recently in this laboratory, peat obtained from Ootacamund (Nilgiris) has been found to be an efficient carrier for *Rhizobium*.[3] The survival of the applied rhizobia in this material is quite high as compared to soil because of its high organic matter content, better aeration and greater water-holding capacity which are all helpful for the purpose.[1,2,4]

Cultures of *Rhizobium japonicum* are very sensitive to high temperatures. In our country where the soil temperature may reach values higher than 35° C, it is obviously an important factor for the survival of rhizobia present in soil and added inoculum with soil and seed.

During the present study the peat culture for soybean prepared in this laboratory was compared with the imported cultures during *Kharif* 1969 at the following centres:

Delhi, Pantnagar, Jabalpur, Kalyani, Amravati, Junagarh and Katrain using the varieties Bragg and Lee. The nodulation status and yield of soybean are given in Tables I and II.

been appreciably improved by the I.A.R.I., and imported peat-based cultures in all other centres. From Table II it is clear that the peat cultures prepared in this laboratory had proved to be at par with the imported peat cultures in the case of Pantnagar, Jabalpur, Amravati and significantly superior in the case of Kalyani, Junagarh and Katrain in their performance.

In previous years soil cultures were being used and since the sowing of soybean was done in the month of June or July, the temperature was quite high and survival on the seed of the order of 10^3–10^5/seed might not have reached at the time of sowing since soybean *Rhizobium* was sensitive to high temperatures.

TABLE I

Field experiment (Kharif *1969*)—*Nodulation status*

Treatments	Var. Bragg							Var. Lee
	Delhi (Alluvial soil)	Pantnagar (Foot hill swampy soil)		Jabalpur (Shallow black soil)	Kalyani (New alluvial soil)	Amravati (Medium black soil)	Junagarh (Medium black soil)	Katrain (Sub-montane) regional soil
		Expt. I*	Expt. II					
No culture ..	16	40	4	7	29	12	2	20
Imported peat cultures:								
Nitragin ..	18	56	36	25	..	58	18	..
Legumeaid ..	..	..	..	16	313	..	..	30
IARI peat cultures:								
SB- 1 ..	14	..	..	26	419	59	23	76
SB- 5 ..	12	..	..	..	319	73	43	132
SB- 7 ..	10	..	68	..	966	38	33	61
SB-16 ..	17	56	..	34	634	79	24	98

* Expt. I was a demonstration trial.

TABLE II

Field experiment (Kharif 1969)—*Yield of soybean*

Treatments	Var. Bragg-Yield in quintals per hectare						Var. Bragg	Var. Lee
	Delhi	Pantnagar		Jabalpur	Kalyani	Amravati	Junagarh yield—beans kg./plot	Katrain yield—beans quin./hectare
		Expt. I*	Expt. II					
No culture ..	19·21	24·25	29·22	18·03	24·26	7·25	0·266	33·33
Imported peat cultures:								
Nitragin ..	19·15	47·25	43·92	36·23	..	11·91	0·422	..
Legumeaid ..	..	..	..	30·30	30·92	..	..	44·85
IARI peat cultures:								
SB- 1 ..	19·33	..	..	34·15	37·23	10·28	0·556	44·14
SB- 5 ..	18·16	..	..	..	32·69	14·08	0·550	34·16
SB- 7 ..	17·79	..	42·41	..	34·73	10·71	0·395	33·33
SB-16 ..	16·78	45·79	..	32·83	41·50	14·55	0·496	33·33
C.D. at 5% ..	Not significant	Not given	9·13	7·17	5·63	3·67	0·108	6·20

* Expt. I was a demonstration trial.

The data in Table I show that only in the case of Delhi the control showed 16 nodules per plant, since soybean has been grown earlier in this area while nodulation of soybean had

Since peat carried a higher moisture content as compared to soil and could take more of the inoculum, the use of peat based culture has an obvious advantage of higher survival on seed giving rise to better establishment and infection leading to an increase in nodulation and yield. The result of this peat culture trial showed that the yield of soybean could be increased by inoculation with Indian strains of soybean *Rhizobium*. It was time that these cultures were multiplied on a large scale and used in future.

The authors thank Shri H. B. Singh, Chief Coordinator, Soybean Scheme, for his help in conducting the trials at various centres.

Division of Microbiology,
I.A.R.I., New Delhi-12,
V. R. BALASUNDARAM.
V. ISWARAN.
W. V. B. SUNDARA RAO.

February 12, 1970.

---

1. Date, R. A., *MSc. Thesis*, Univ. of Sydney, 1959
2. Hedlin, R. A. and Newton, S. D., *Can. J. Res.*, 1948, **26**, 174.
3. Iswaran, V., Sundara Rao, W. V. B., Magu, S. P., and Jauhri, K. S., *Curr. Sci.*, 1969, **38**, 468.
4. Newbould, F. H. S., *Sci. Agric*, 1951, **31**, 463.

ON THE OCCURRENCE OF SUPERNUMERARY CHROMOSOMES IN THE GENUS *APLUDA*

Apluda is a monotypic genus belonging to the tribe *Andropogoneæ*, of grasses. It has a wide distribution in E. Tropical Asia extending from Mauritius and Socotra in the Indian Ocean, through India, Ceylon, Malaya, China and Formosa to the distant islands of the Pacific Ocean. It has also been reported from Australia. Linnaeus in 1753 described the unawned form of this grass as *Apluda mutica* and the awned one as *A. aristata* in 1756. Heckel in 1889 combined both these into a single species *Apluda varia* of which he had two subspecies, *subsp. aristata* and *subsp. mutica*.

The single species *Apluda varia* of Heckel is, according to Hooker (1897), both "unstable and polymorphic". Bor (1960) has merged the two subspecies and their varieties under *Apluda mutica* Linn. According to him, "This species needs a thorough investigation by the methods of experimental taxonomy".

Bombay specimens are referable to the subspecies *aristata* in Cook's *Flora of Bombay* (1908).

It is a slender variable grass growing extensively on the slopes of Trombay Hill. It is considered a good fodder grass for horses. Twelve plants selected at random were examined cytologically. Of these, eight showed 10 bivalents at meiosis in pollen mother cells, while in the remaining four—one or two supernumerary chromosomes were seen, besides the 10 bivalents. These supernumeraries were smaller than the normal chromosome complex with which they did not pair. They failed to congress on the metaphase plate and were distributed at random to the poles.

The origin, distribution and evolutionary significance of these supernumerary chromosomes may throw light on the polymorphism exhibited by this widely distributed genus which has been relegated by Hooker into a separate subtribe in the great family of grasses. It is possible that a more extensive survey in other parts of India might reveal the existence of polyploids in the species.

Biology Division,
Bhabha Atomic Research Centre,
Trombay, Bombay-85,
E. K. JANAKI AMMAL.
V. ABRAHAM.

February 10, 1970.

---

1. Bor, N. L., *The Grasses of Burma, Ceylon, India and Pakistan*, 1960, p. 93.
2. Hooker, J. D., *Flora of British India—Gramineæ*, by Hooker and Stapf, 1897, **7**, 150.

ERADICATION OF SEED INFECTION OF BLACK ARM OF COTTON

THE adjustment of date of sowing of cotton[1-2] and regular spraying with antibiotics and fungicides,[3-5] no doubt, reduce the disease incidence, but are of limited value. The most potent method of controlling a disease is to eliminate it at the initial source of inoculum, and to this end seed-dressing in case of seed-borne pathogens, is extremely valuable. As the black arm of cotton is normally externally and sometimes internally seed-borne,[6] chemical control of *Xanthomonas malvacearum* (E. F. Smith) Dowson, the causal organism, has been practised mainly through seed-dressing in conjunction with resistant varieties. Such a treatment gives better germination and also reduced or even eliminated the number of foci from which secondary infection could spread.

In order to eradicate the seed infection of black arm of cotton the seeds of cotton (LL-54, a cultivar of *Gossypium hirsutum* L.) were artificially infected with a virulent mixture of races[7] of *X. malvacearum* and given chemical or hot water treatment. The results were recorded on the basis of disease incidence on cotyledons.

Of the various chemicals used, including fungicides, antibiotics, copper and mercury derivatives, it was observed that plantvax (2, 3 - dihydro - 5 - carboxanilido - 6 - methyl -

1, 4-oxathin-4, 4-dioxide), a systemic fungicide, at 1% concentration successfully controlled the seed-borne infection. Busan-72, vitavax and ceresan + streptocycline were also effective in the eradication of seed infection. It may, however, be mentioned that per cent germination in case of Busan-72-treated seeds was only 20% of control and other chemically-treated seeds.

In hot water treatment, the artificially infected seeds were exposed to temperatures of 45, 50, 52, 54, 56, 58 and 60° C. for 10 minutes. The results recorded on the basis of cotyledonary infection indicated that treatment at 56° C. effectively controlled the infection without any significant effect on the viability of the seeds.

It may be mentioned that our observations indicate that artificially-infected seeds are free of infection after one year. Another important observation appears to be that under laboratory conditions some of the insecticides (*e.g.*, phosphamidon, diazinon, morocide, furdan and baygon) inhibit almost completely the growth of *X. malvaccarum* at 0·1% concentration. This leads to two interesting possibilities. First that as some of them are systemic they can be used for seed treatment to eradicate internally seed-borne infection and secondly that a spray of insecticide alone may control both insect pests and fungal or bacterial diseases.

The authors are grateful to Professor S. P. Raychaudhuri, Head, Division of Mycology, IARI, for his keen interest and help throughout these investigations.

Div. of Mycology and
Plant Pathology, IARI,
New Delhi, *January* 5, 1970.

R. P. Singh.
J. P. Verma.
Y. P. Rao.

---

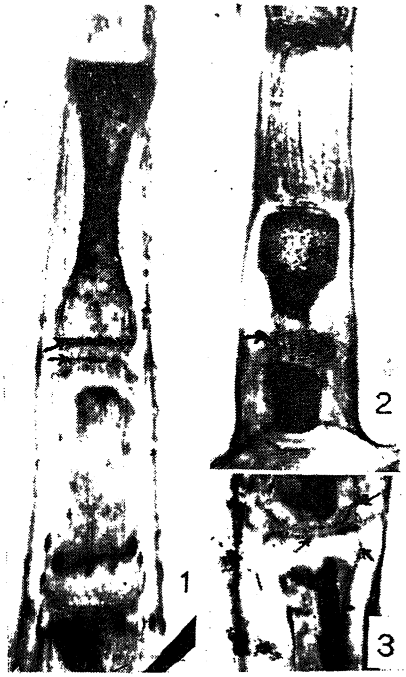
1. Sahni, V. M. and Gera, S. D., *Agric. Res.*, 1965, **5**, 342.
2. Simlote, K. M. and Bharadwaj, R. D., *Ind. Agriculturist*, 1967, **11**, 103.
3. Gera, S. D. and Sahni, V. M., *Agric. Res.*, 1965, **5**, 15.
4. Deshaprabhu, N. N. and Hanumantha, H. K., *Mad. Agric. J.*, 1969, **56**, 185.
5. Bhandari, D. R., Singh, R. R. and Bharadwaj, R. D., *Ibid.*, 1969, **56**, 485.
6. Brinkerhoff, L. A. and Hunter, R. E., *Phytopath.*, 1963, **53**, 1397.
7. Verma, J. P. and Singh, R. P., *Curr. Sci.*, 1970, **39**, 20.

PLASMODESMATA IN THE HAIRS OF *LEPTADENIA RETICULATA* W. & A.

According to Fahn,[1] plasmodesmata are apparently present in all living cells of higher plants. However, their presence between the guard cells and surrounding cells is controversial. To the best of our knowledge, no report exists on the occurrence of plasmodesmata between hair cells (*see* Meeuse,[3] Uphof and Hummel[4]). The present paper describes the occurrence of plasmodesmata between adjacent hair cells.

For the demonstration of plasmodesmata, epidermal peels were taken from the leaf of *Leptadenia reticulata*. Plasmodesmata can be very easily demonstrated in temporary whole mounts of leaf epidermis, following the method of Johansen.[2]

In the conical trichomes, plasmodesmata connecting the protoplasts of adjacent hair cells are observed in between all cells from basal to terminal. In Figs. 1 and 3, the black points at the inner wall (periclinal) on either side are little end knots of plasmodesmata, the protoplasmic strands of which crossing the walls are not visible here, while they are visible in Figs. 1 and 2, where in between two adjacent cells a lot of structures somewhat curved appear over cross-walls connecting the protoplasts of neighbouring cells. The presence of plasmodesmata in between neighbouring hair cells from basal to terminal is indicative of the physiological connection of the trichomes with the leaf tissue.



Figs. 1-3. *Leptadenia reticulata* (Figs. 1-3. Plasmodesmata marked by arrows between adjacent hair cells; note cytoplasmic strands crossing over the transverse walls in Fig. 2). Figs. 1 & 3, × 920. Fig. 2, × 1,100.

We express our sincere thanks to Prof. Dr. Wolfgang Franke, Institut Fur Landwirtschaftl

Botanik, Der Universitat Bonn, Bonn, West Germany, for confirming our results. We are thankful to Principal J. G. Chohan for his interest in our work. One of us (R. C. P.) thanks the University Grants Commission for financial assistance.

Department of Botany, J. A. INAMDAR
Sardar Patel University, R. C. PATEL
Vallabh Vidyanagar, D. C. BHATT.
Gujarat, *January* 25, 1970.

---

1. Fahn, A., *Plant Anatomy*, Pergamon Press, Oxford 1967.
2. Johansen, D. A., *Plant Microtechnique*, McGraw Hill. Inc., New York, 1940.
3. Meeuse, A. J. D., "Plasmodesmata," *Bot. Rev.*, 1941, 7 (5), 249.
4. Uphof, J. C. Th. and Hummel, K., "Plant hairs," *Encyclopedia of Plant Anatomy*, Berlin, 1962, 4 (5)

GLYPHIUM TILLANDSIAE (CASH) ZOGG—A NEW GENUS RECORD TO INDIA

IN the course of our survey for new fungi, we encountered an interesting Ascomycete at Khandala (Poona) growing saprophytically on dead culms of *Cymbopogon martini* (Graminæ), which on critical examination was identified as a species of the hysteriaceous genus *Glyphium* Nit. ex Lehmann. The results of a detailed study of this rare fungus is presented in this note.

The name *Glyphium* was first proposed by Nitschke but validly published by his pupil Lehmann in 1886.[3] This genus is represented by three known species collected from North Africa, U.S.A., Europe and described recently by Zogg (1962). Of the three known species of this genus, *Glyphium tillandsiæ* (Cash) Zogg was described by Cash (1943) from Florida, North America (U.S.A.), as *Lophium tillandsiæ* Cash. The two other species of *Glyphium*, viz., *G. elatum* and *G. schizosporum* have been collected on 11 hosts from North Africa and Europe.

Bisby and Ellis (1952) suggested the usage of the name *Glyphium* Nit. ex Lehm. instead of *Lophium* in describing the fungus *Lophium elatum* (Greville, 1825). Zogg (1962) has followed this terminology and considered *Glyphium elatum* (= *Lophium elatum* Grev.) as the type species of the genus *Glyphium*.

Critical comparative studies revealed that the authors' collection of *Glyphium* agreed in all respects with *Glyphium tillandsiæ* (Cash) Zogg.

Glyphium tillandisæ (Cash) Zogg.

Hysterothecia in small groups, scattered, erect, orange to dark brown in colour, obovate, broader at the top, narrowed towards [illegible], with a depressed circular opening at the top, 330-540 µ high and 220-310 µ wide, [illegible] with short, multicellular and [illegible] arising from the base of the [illegible] dark brown, [illegible]

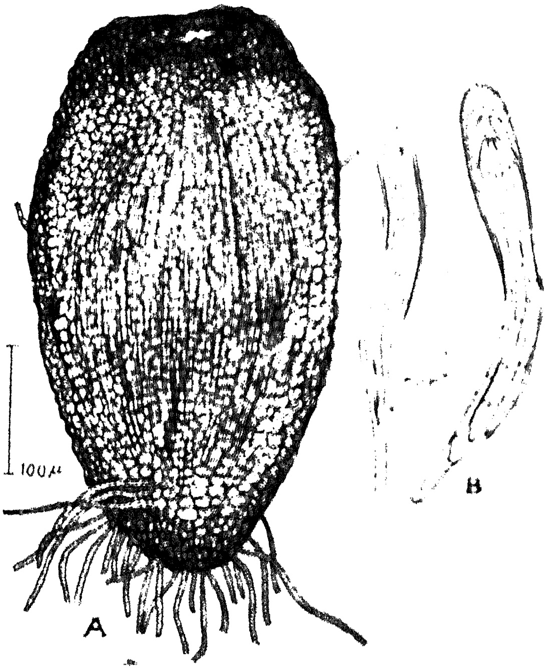


FIG. 1. A, Hysterothecium, B, [illegible]

Asci linear obclavate, [illegible] pedicellate, thickened at the apex, [illegible] layers; 8-spored, 210-308 × 8-11 µ.

Ascospores subhyaline, [illegible] septate, linear, 176-288 × 2-3 µ.

Interthecial threads numerous, [illegible] hyaline.

On the culms of *Cymbopogon martini* (Graminæ), Leg. P. G. Patwardhan at Khandala (Poona) on 21st August [illegible] M.A.C.S. Herb. No. 811.

The fungus is a new genus record to India and *Cymbopogon martini* a new host for the fungus. Material of the fungus is being deposited at the Herb. Crypt. Orientalis, New Delhi (India).

We are grateful to Prof. M. N. Kamat for helpful suggestions in the preparation of the manuscript and to the Director for library and laboratory facilities.

Division of Mycology and P. G. PATWARDHAN
Plant Pathology, G. T. [illegible]
M.A.C.S., Poona-4, *January* 25, 1970.

---

1. Bisby, G. R. and Ellis, M. B., *Trans. Brit. Mycol. Soc.*, 1952, 35, 209.
2. Cash, E. K., *Mycologia*, 1943, 35, 595.
3. Zogg, H., *Beitr. Krypt. Schweiz.*, 1962, 11 (3), 190.

REVIEWS AND NOTICES OF BOOKS

Structure and Mechanism in Vinyl Polymerization. Edited by Teiji Tsuruta and Kenneth F. O'Driscoll. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 540. Price $29.50 or £14 0 *sh.* 0 *d.*

Until some twenty years ago it was necessary to proceed with the polymerization of a new vinyl monomer in a trial-and-error fashion. Fortunately, the situation has improved enormously in recent years, and numerous generalizations can be made which are valid for many vinyl compounds. Now, much of this comprehensive knowledge about the reactivity of vinyl compounds has been compiled in one source. The objective of this book is to present a general survey of studies concerning "Structure and Mechanism in Vinyl Polymerization in terms of physical organic chemistry. The reader's attention is focused on the most important chemical features of vinyl compounds and their response to variations in chemical and physical conditions. Basic concepts necessary for an understanding of the interrelation between structure and mechanism as it operates in vinyl polymerization are discussed. The various chapters pay particular attention to the elementary reactions in free radical, cationic, and anionic polymerizations, and include such special topics as heterogeneous metal peroxides, metal alkyl catalysts, polymerization of α, β-unsaturated carbonyls, and molecular rearrangements in the polymerization of vinyl monomers. Both the academic and the applied polymer scientists will find this book a valuable aid.

C. V. R.

Ecological Aspects of the Mineral Nutrition of Plants: British Ecological Society Symposium Number Nine. Edited by I. H. Rorison (Blackwell Scientific Publications, Oxford and Edinburgh), 1969. Pp. xxi + 484. Price £5.

Ecologists have long been interested in the relationship between the mineral nutrition of plants and their distribution, but knowledge of basic nutritional concepts has been more vigorously advanced by specialists in other fields. At the Symposium held at Sheffield in April 1968, agronomists, physiologists, and soil chemists were brought together with ecologists to consider current knowledge of the mineral nutrition of plants and particularly of those processes by which nutritional facts influence plant distribution. Each of the 32 contributors gave an interpretation of concepts and methods from the viewpoint of his own discipline and an attempt was made to present an integrated appraisal of fundamental problems rather than a detailed study of any one ecological situation.

The volume is divided into five sections: the definitions and experimental investigation of problems in the field; a review of recent work on the properties of ions in the soil as they affect uptake by plants; evidence from experiments in which whole plants are used in investigating a limited number of factors at a physiological level, and its relevance in interpreting ecological problems; consideration of mechanisms of uptake and toxicity of ions of ecological interest studied at the tissue and cellular level; and a final section in which an ecologist, a soil chemist and physiologist give personal assessments of the major advances which have been made and the objectives which remain. An account of the discussion following each section is also included.

C. V. R.

Chemical Evolution. By Melvin Calvin. (Oxford University Press, London, and Oxford University Press, Oxford House, Mount Road, Madras-6), 1969. Pp. 278. Price 25 sh. or Rs. 22·50.

The study of chemical evolution is based on the assumption that life appeared on the earth's surface as a result of the normal operation of physical and chemical laws. This implies that there was a period in the earth's history that encompassed the transition between non-living molecules and a population of molecular aggregates that we should call 'living'.

In this book, based on a series of lectures given in Oxford by Professor Calvin as George Eastman, Visiting Professor, two approaches are used in the attempt to determine the nature of this interface and transition. The first, molecular palæontology is the view backwards into the historical record; the second is the construction of hypothetical chemical models that could have given rise to living organisms. Both approaches are discussed in some detail.

Botanik, Der Universitat Bonn, Bonn, West Germany, for confirming our results. We are thankful to Principal J. G. Chohan for his interest in our work. One of us (R. C. P.) thanks the University Grants Commission for financial assistance.

Department of Botany,
Sardar Patel University,
Vallabh Vidyanagar,
Gujarat, *January* 25, 1970.

J. A. INAMDAR.
R. C. PATEL.
D. C. BHATT.

---

1. Fahn, A., *Plant Anatomy*, Pergamon Press, Oxford 1967.
2. Johansen, D. A., *Plant Microtechnique*, McGraw-Hill. Inc., New York, 1940.
3. Meeuse, A. J. D., "Plasmodesmata," *Bot. Rev.*, 1941, 7 (5), 249.
4. Uphof, J. C. Th. and Hummel, K., "Plant hairs," *Encyclopedia of Plant Anatomy*, Berlin, 1962, 4 (5)

GLYPHIUM TILLANDSIAE (CASH) ZOGG—A NEW GENUS RECORD TO INDIA

IN the course of our survey for new fungi, we encountered an interesting Ascomycete at Khandala (Poona) growing saprophytically on dead culms of *Cymbopogon martini* (Graminæ), which on critical examination was identified as a species of the hysteriaceous genus *Glyphium* Nit. ex Lehmann. The results of a detailed study of this rare fungus is presented in this note.

The name *Glyphium* was first proposed by Nitschke but validly published by his pupil Lehmann in 1886.[3] This genus is represented by three known species collected from North Africa, U.S.A., Europe and described recently by Zogg (1962). Of the three known species of this genus, *Glyphium tillandsiœ* (Cash) Zogg was described by Cash (1943) from Florida, North America (U.S.A.), as *Lophium tillandsiœ* Cash. The two other species of *Glyphium*, viz., *G. elatum* and *G. schizosporum* have been collected on 11 hosts from North Africa and Europe.

Bisby and Ellis (1952) suggested the usage of the name *Glyphium* Nit. ex Lehm. instead of *Lophium* in describing the fungus *Lophium elatum* (Greville, 1825). Zogg (1962) has followed this terminology and considered *Glyphium elatum* (= *Lophium elatum* Grev.) as the type species of the genus *Glyphium*.

Critical comparative studies revealed that the authors' collection of *Glyphium* agreed in all respects with *Glyphium tillandsiœ* (Cash) Zogg.

Glyphium tillandisœ (Cash) Zogg.

Hysterothecia in small groups, scattered, erect, orange to dark brown in colour, obovate, broader at the top, narrowed towards the base, with a depressed circular opening at the top; 330–540 μ high and 220–310 μ wide, provided with short, multicelluar dark brown hyphæ arising from the base of the ascocarp, wall cells dark brown, polygonal.

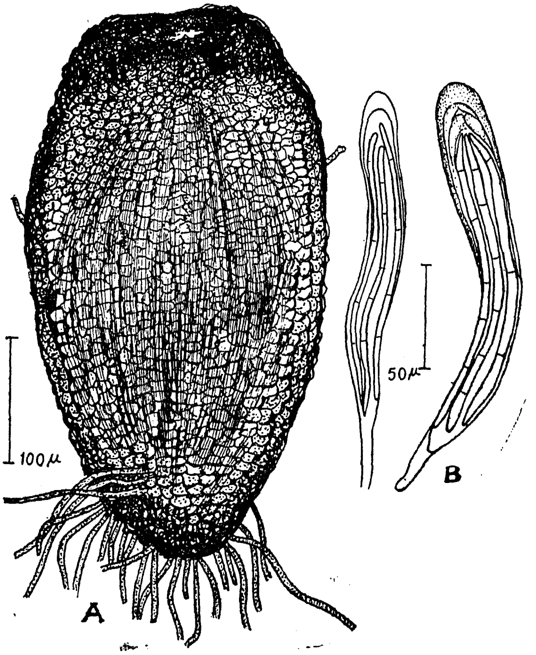


FIG. 1. A, Hysterothecium; B, Asci with ascospores

Asci linear-obclavate, bitunicate, shortly pedicellate, thickened at the apex, in basal layers; 8-spored; 210–308 × 8–11·5 μ.

Ascospores subhyaline, olivaceous, multiseptate, linear; 176–288 × 2–3 μ.

Interthecial threads numerous, filiform, subhyaline.

On the culms of *Cymbopogon martini* (Graminæ); Leg. P. G. Patwardhan, at Khandala (Poona) on 21st August 1969, M.A.C.S. Herb. No. 811.

The fungus is a new genus record to India and *Cymbopogon martini* a new host for the fungus. Material of this fungus is being deposited at the Herb. Crypt. Orientalis, New Delhi (India).

We are grateful to Prof. M. N. Kamat for helpful suggestions in the preparation of the manuscript and to the Director for library and laboratory facilities.

Division of Mycology and
Plant Pathology,
M.A.C.S., Poona-4, *January* 25, 1970.

P. G. PATWARDHAN.
G. T. JOSHI.

---

1. Bisby, G. R. and Ellis, M. B., *Trans. Brit. Mycol. Soc.*, 1952, 35, 299.
2. Cash, E. K., *Mycologia*, 1943, 35, 595.
3. Zogg, H., *Beitr. Krypt. Schwz.*, 1962, 11 (3), 190.

REVIEWS AND NOTICES OF BOOKS

Structure and Mechanism in Vinyl Polymerization. Edited by Teiji Tsuruta and Kenneth F. O'Driscoll. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 540. Price $29.50 or £14 0 *sh.* 0 *d.*

Until some twenty years ago it was necessary to proceed with the polymerization of a new vinyl monomer in a trial-and-error fashion. Fortunately, the situation has improved enormously in recent years, and numerous generalizations can be made which are valid for many vinyl compounds. Now, much of this comprehensive knowledge about the reactivity of vinyl compounds has been compiled in one source. The objective of this book is to present a general survey of studies concerning "Structure and Mechanism in Vinyl Polymerization" in terms of physical organic chemistry. The readers attention is focused on the most important chemical features of vinyl compounds and their response to variations in chemical and physical conditions. Basic concepts necessary for an understanding of the interrelation between structure and mechanism as it operates in vinyl polymerization are discussed. The various chapters pay particular attention to the elementary reactions in free radical, cationic, and anionic polymerizations, and include such special topics as heterogeneous metal peroxides, metal alkyl catalysts, polymerization α,β-unsaturated carbonyls, and molecular rearrangements in the polymerization of vinyl monomers. Both the academic and the applied polymer scientists will find this book a valuable aid

C. V. R.

Ecological Aspects of the Mineral Nutrition of Plants: British Ecological Society Symposium Number Nine. Edited by I. H. Rorison. (Blackwell Scientific Publications, Oxford and Edinburgh), 1969. Pp. xxi + 484. Price £5.

Ecologists have long been interested in the relationship between the mineral nutrition of plants and their distribution, but knowledge of basic nutritional concepts has been more vigorously advanced by specialists in other fields. At this Symposium held at Sheffield in April 1968, agronomists, physiologists, and soil chemists were brought together with ecologists to consider current knowledge of the mineral nutrition of plants and particularly of those processes by which nutritional facts influence plant distribution. Each of the 32 contributors gave an interpretation of concepts and methods from the viewpoint of his own discipline and an attempt was made to present an integrated appraisal of fundamental problems rather than a detailed study of any one ecological situation.

The volume is divided into five sections: the definitions and experimental investigation of problems in the field; a review of recent work on the properties of ions in the soil as they affect uptake by plants; evidence from experiments in which whole plants are used in investigating a limited number of factors at a physiological level, and its relevance in interpreting ecological problems; consideration of mechanisms of uptake and toxicity of ions of ecological interest studied at the tissue and cellular level; and a final section in which an ecologist, a soil chemist and physiologist give personal assessments of the major advances which have been made and the objectives which remain. An account of the discussion following each section is also included.

C. V. R.

Chemical Evolution. By Melvin Calvin. (Oxford University Press, London, and Oxford University Press, Oxford House, Mount Road, Madras-6), 1969. Pp. 278. Price 25 sh. or Rs. 22·50.

The study of chemical evolution is based on the assumption that life appeared on the earth's surface as a result of the normal operation of physical and chemical laws. This implies that there was a period in the earth's history that encompassed the transition between non-living molecules and a population of molecular aggregates that we should call 'living'.

In this book, based on a series of lectures given in Oxford by Professor Calvin as George Eastman, Visiting Professor, two approaches are used in the attempt to determine the nature of this interface and transition. The first, molecular palæontology is the view backwards into the historical record; the second is the construction of hypothetical chemical models that could have given rise to living organisms. Both approaches are discussed in some detail.

Botanik, Der Universitat Bonn, Bonn, West Germany, for confirming our results. We are thankful to Principal J. G. Chohan for his interest in our work. One of us (R. C. P.) thanks the University Grants Commission for financial assistance.

Department of Botany,
Sardar Patel University,
Vallabh Vidyanagar,
Gujarat, *January* 25, 1970.

J. A. INAMDAR.
R. C. PATEL.
D. C. BHATT.

---

1. Fahn, A., *Plant Anatomy*, Pergamon Press, Oxford 1967.
2. Johansen, D. A., *Plant Microtechnique*, McGraw-Hill. Inc., New York, 1940.
3. Meeuse, A. J. D., "Plasmodesmata," *Bot. Rev.*, 1941, 7 (5), 249.
4. Uphof, J. C. Th. and Hummel, K., "Plant hairs," *Encyclopedia of Plant Anatomy*, Berlin, 1962, 4 (5)

GLYPHIUM TILLANDSIAE (CASH) ZOGG—A NEW GENUS RECORD TO INDIA

In the course of our survey for new fungi, we encountered an interesting Ascomycete at Khandala (Poona) growing saprophytically on dead culms of *Cymbopogon martini* (Graminæ), which on critical examination was identified as a species of the hysteriaceous genus *Glyphium* Nit. ex Lehmann. The results of a detailed study of this rare fungus is presented in this note.

The name *Glyphium* was first proposed by Nitschke but validly published by his pupil Lehmann in 1886.[3] This genus is represented by three known species collected from North Africa, U.S.A., Europe and described recently by Zogg (1962). Of the three known species of this genus, *Glyphium tillandsiœ* (Cash) Zogg was described by Cash (1943) from Florida, North America (U.S.A.), as *Lophium tillandsiœ* Cash. The two other species of *Glyphium*, viz., *G. elatum* and *G. schizosporum* have been collected on 11 hosts from North Africa and Europe.

Bisby and Ellis (1952) suggested the usage of the name *Glyphium* Nit. ex Lehm. instead of *Lophium* in describing the fungus *Lophium elatum* (Greville, 1825). Zogg (1962) has followed this terminology and considered *Glyphium elatum* (= *Lophium elatum* Grev.) as the type species of the genus *Glyphium*.

Critical comparative studies revealed that the authors' collection of *Glyphium* agreed in all respects with *Glyphium tillandsiœ* (Cash) Zogg.

Glyphium tillandisœ (Cash) Zogg.

Hysterothecia in small groups, scattered, erect, orange to dark brown in colour, obovate, broader at the top, narrowed towards the base, with a depressed circular opening at the top; 330–540 μ high and 220–310 μ wide, provided with short, multicelluar dark brown hyphæ arising from the base of the ascocarp, wall cells dark brown, polygonal.

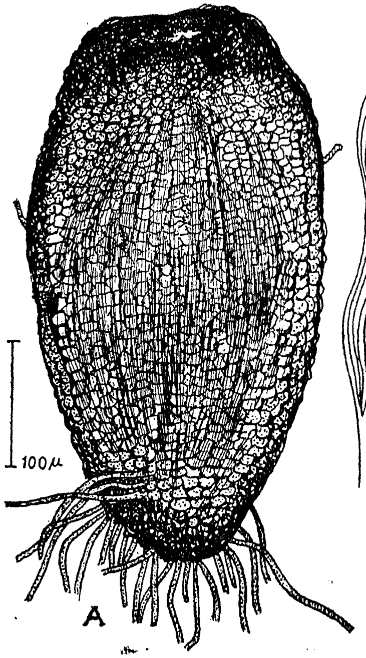


FIG. 1. A, Hysterothecium; B, Asci with ascospores

Asci linear-obclavate, bitunicate, shortly pedicellate, thickened at the apex, in basal layers; 8-spored; 210–308 × 8–11·5 μ.

Ascospores subhyaline, olivaceous, multiseptate, linear; 176–288 × 2–3 μ.

Interthecial threads numerous, filiform, subhyaline.

On the culms of *Cymbopogon martini* (Graminæ); Leg. P. G. Patwardhan, at Khandala (Poona) on 21st August 1969, M.A.C.S. Herb. No. 811.

The fungus is a new genus record to India and *Cymbopogon martini* a new host for the fungus. Material of this fungus is being deposited at the Herb. Crypt. Orientalis, New Delhi (India).

We are grateful to Prof. M. N. Kamat for helpful suggestions in the preparation of the manuscript and to the Director for library and laboratory facilities.

Division of Mycology and
Plant Pathology,
M.A.C.S., Poona-4, *January* 25, 1970.

P. G. PATWARDHAN.
G. T. JOSHI.

---

1. Bisby, G. R. and Ellis, M. B., *Trans. Brit. Mycol. Soc.*, 1952, 35, 299.
2. Cash, E. K., *Mycologia*, 1943, 35, 595.
3. Zogg, H., *Beitr. Krypt. Schwz.*, 1962, 11 (3), 190.

REVIEWS AND NOTICES OF BOOKS

Structure and Mechanism in Vinyl Polymerization. Edited by Teiji Tsuruta and Kenneth F. O'Driscoll. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 340. Price $29.50 or £14 0 *sh.* 0 *d.*

Until some twenty years ago it was necessary to proceed with the polymerization of a new vinyl monomer in a trial-and-error fashion. Fortunately the situation has improved enormously in recent years, and numerous generalizations can be made which are valid for many vinyl compounds. Now, much of this comprehensive knowledge about the reactivity of vinyl compounds has been compiled in one source. The objective of this book is to present a general survey of studies concerning Structure and Mechanism in Vinyl Polymerization in terms of physical organic chemistry. The reader's attention is focused on the most important chemical features of vinyl compounds and their response to variations in chemical and physical condition. Basic concepts necessary for an understanding of the interrelation between structure and mechanism as it operates in vinyl polymerization are discussed. The various chapters pay particular attention to the elementary reactions in free radical, cationic and anionic polymerizations, and include such special topics as heterogeneous metal peroxides, metal alkyl catalysts, polymerization of unsaturated carbonyls, and molecular rearrangements in the polymerization of vinyl monomers. Both the academic and the applied polymer scientists will find this book a valuable aid.

C. V. R.

Ecological Aspects of the Mineral Nutrition of Plants: British Ecological Society Symposium Number Nine. Edited by I. H. Rorison (Blackwell Scientific Publications, Oxford and Edinburgh), 1969. Pp. xxi + 484. Price £5.

Ecologists have long been interested in the relationship between the mineral nutrition of plants and their distribution, but knowledge of basic nutritional concepts has been more vigorously advanced by specialists in other fields. At this Symposium held at Sheffield in April 1968, agronomists, physiologists, and soil chemists were brought together with ecologists to consider current knowledge of the mineral nutrition of plants and particularly of those processes by which nutritional facts influence plant distribution. Each of the 32 contributors gave an interpretation of concepts and methods from the viewpoint of his own discipline and an attempt was made to present an integrated appraisal of fundamental problems rather than a detailed study of any one ecological situation.

The volume is divided into five sections: the definitions and experimental investigation of problems in the field; a review of recent work on the properties of ions in the soil as they affect uptake by plants; evidence from experiments in which whole plants are used in investigating a limited number of factors at a physiological level, and its relevance in interpreting ecological problems; consideration of mechanisms of uptake and toxicity of ions of ecological interest studied at the tissue and cellular level; and a final section in which an ecologist, a soil chemist and physiologist give personal assessments of the major advances which have been made and the objectives which remain. An account of the discussion following each section is also included.

C. V. R.

Chemical Evolution. By Melvin Calvin. (Oxford University Press, London, and Oxford University Press, Oxford House, Mount Road, Madras-6), 1969. Pp. 278. Price 25 sh. or Rs. 22·50.

The study of chemical evolution is based on the assumption that life appeared on the earth's surface as a result of the normal operation of physical and chemical laws. This implies that there was a period in the earth's history that encompassed the transition between non-living molecules and a population of molecular aggregates that we should call 'living'.

In this book, based on a series of lectures given in Oxford by Professor Calvin as George Eastman, Visiting Professor, two approaches are used in the attempt to determine the nature of this interface and transition. The first, molecular palæontology is the view backwards into the historical record; the second is the construction of hypothetical chemical models that could have given rise to living organisms. Both approaches are discussed in some detail.

Botanik, Der Universitat Bonn, Bonn, West Germany, for confirming our results. We are thankful to Principal J. G. Chohan for his interest in our work. One of us (R. C. P.) thanks the University Grants Commission for financial assistance.

Department of Botany,
Sardar Patel University,
Vallabh Vidyanagar,
Gujarat, *January* 25, 1970.

J. A. INAMDAR.
R. C. PATEL.
D. C. BHATT.

---

1. Fahn, A., *Plant Anatomy*, Pergamon Press, Oxford 1967.
2. Johansen, D. A., *Plant Microtechnique*, McGraw Hill. Inc., New York, 1940.
3. Meeuse, A. J. D., "Plasmodesmata," *Bot. Rev.*, 1941, 7 (5), 249.
4. Uphof, J. C. Th. and Hummel, K., "Plant hairs," *Encyclopedia of Plant Anatomy*, Berlin, 1962, 4 (5)

GLYPHIUM TILLANDSIAE (CASH) ZOGG—A NEW GENUS RECORD TO INDIA

IN the course of our survey for new fungi, we encountered an interesting Ascomycete at Khandala (Poona) growing saprophytically on dead culms of *Cymbopogon martini* (Graminæ), which on critical examination was identified as a species of the hysteriaceous genus *Glyphium* Nit. ex Lehmann. The results of a detailed study of this rare fungus is presented in this note.

The name *Glyphium* was first proposed by Nitschke but validly published by his pupil Lehmann in 1886.[3] This genus is represented by three known species collected from North Africa, U.S.A., Europe and described recently by Zogg (1962). Of the three known species of this genus, *Glyphium tillandsiæ* (Cash) Zogg was described by Cash (1943) from Florida, North America (U.S.A.), as *Lophium tillandsiæ* Cash. The two other species of *Glyphium*, viz., *G. elatum* and *G. schizosporum* have been collected on 11 hosts from North Africa and Europe.

Bisby and Ellis (1952) suggested the usage of the name *Glyphium* Nit. ex Lehm. instead of *Lophium* in describing the fungus *Lophium elatum* (Greville, 1825). Zogg (1962) has followed this terminology and considered *Glyphium elatum* (= *Lophium elatum* Grev.) as the type species of the genus *Glyphium*.

Critical comparative studies revealed that the authors' collection of *Glyphium* agreed in all respects with *Glyphium tillandsiæ* (Cash) Zogg.

Glyphium tillandisœ (Cash) Zogg.

Hysterothecia in small groups, scattered, erect, orange to dark brown in colour, obovate, broader at the top, narrowed towards the base, with a depressed circular opening at the top, 330–540 µ high and 220–310 µ wide, provided with short, multicellular dark brown hyphæ arising from the base of the ascocarp; wall cells dark brown, polygonal.

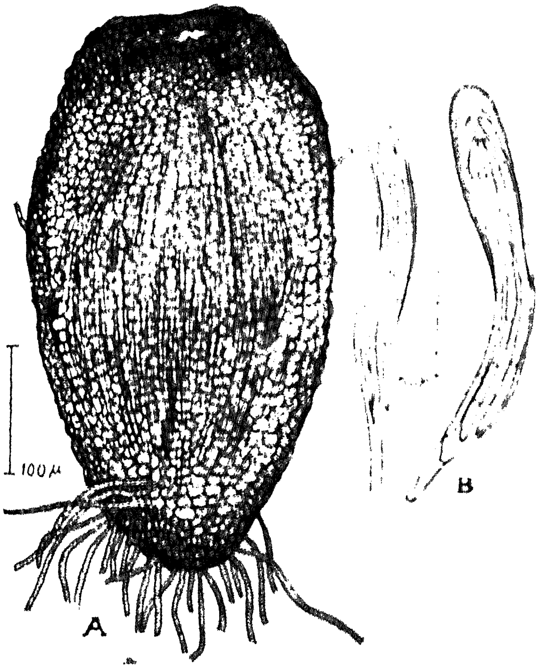


FIG. 1. A, Hysterothecium. B, Ascus with ascospores.

Asci linear-obclavate, bitunicate, short pedicellate, thickened at the apex in [illegible] layers; 8-spored; 210–308 × 8–11.5 µ.

Ascospores subhyaline, olivaceous, multiseptate, linear; 176–288 × 2–3 µ.

Interthecial threads numerous, filiform, subhyaline.

On the culms of *Cymbopogon martini* (Graminæ); Leg. P. G. Patwardhan at Khandala (Poona) on 21st August 1969 M.A.C.S. Herb. No. 811.

The fungus is a new genus record to India and *Cymbopogon martini* a new host for the fungus. Material of this fungus is being deposited at the Herb. Crypt. Orientale, New Delhi (India).

We are grateful to Prof. M. N. Kamat for helpful suggestions in the preparation of the manuscript and to the Director for library and laboratory facilities.

Division of Mycology and
Plant Pathology,
M.A.C.S., Poona-4, *January* 25, 1970.

P. G. PATWARDHAN.
G. T. Joshi.

---

1. Bisby, G. R. and Ellis, M. B., *Trans. Brit. Mycol. Soc.*, 1952, 35, 209.
2. Cash, E. K., *Mycologia*, 1943, 35, 595.
3. Zogg, H., *Beitr. Krypt. Schw.*, 1962, 11 (3), 190.

REVIEWS AND NOTICES OF BOOKS

Structure and Mechanism in Vinyl Polymerization. Edited by Teiji Tsuruta and Kenneth F. O'Driscoll. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 540. Price $ 29.50 or £ 14 0 *sh.* 0 *d.*

Until some twenty years ago it was necessary to proceed with the polymerization of a new vinyl monomer in a trial-and-error fashion. Fortunately, the situation has improved enormously in recent years, and numerous generalizations can be made which are valid for many vinyl compounds. Now, much of this comprehensive knowledge about the reactivity of vinyl compounds has been compiled in one source. The objective of this book is to present a general survey of studies concerning "Structure and Mechanism in Vinyl Polymerization" in terms of physical organic chemistry. The reader's attention is focused on the most important chemical features of vinyl compounds and their response to variations in chemical and physical conditions. Basic concepts necessary for an understanding of the interrelation between structure and mechanism as it operates in vinyl polymerization are discussed. The various chapters pay particular attention to the elementary reactions in free radical, cationic, and anionic polymerizations, and include such special topics as heterogeneous metal peroxides, metal alkyl catalysts, polymerization α-β-unsaturated carbonyls, and molecular rearrangements in the polymerization of vinyl monomers. Both the academic and the applied polymer scientists will find this book a valuable aid.

C. V. R.

Ecological Aspects of the Mineral Nutrition of Plants : British Ecological Society Symposium Number Nine. Edited by I. H. Rorison. (Blackwell Scientific Publications, Oxford and Edinburgh), 1969. Pp. xxi+ 484. Price £ 5.

Ecologists have long been interested in the relationship between the mineral nutrition of plants and their distribution, but knowledge of basic nutritional concepts has been more vigorously advanced by specialists in other fields. At this Symposium held at Sheffield in April 1968, agronomists, physiologists, and soil chemists were brought together with ecologists to consider current knowledge of the mineral nutrition of plants and particularly of those processes by which nutritional facts influence plant distribution. Each of the 32 contributors gave an interpretation of concepts and methods from the viewpoint of his own discipline and an attempt was made to present an integrated appraisal of fundamental problems rather than a detailed study of any one ecological situation.

The volume is divided into five sections : the definitions and experimental investigation of problems in the field ; a review of recent work on the properties of ions in the soil as they affect uptake by plants ; evidence from experiments in which whole plants are used in investigating a limited number of factors at a physiological level, and its relevance in interpreting ecological problems ; consideration of mechanisms of uptake and toxicity of ions of ecological interest studied at the tissue and cellular level ; and a final section in which an ecologist, a soil chemist and physiologist give personal assessments of the major advances which have been made and the objectives which remain. An account of the discussion following each section is also included.

C. V. R.

Chemical Evolution. By Melvin Calvin. (Oxford University Press, London, and Oxford University Press, Oxford House, Mount Road, Madras-6), 1969. Pp. 278. Price 25 sh. or Rs. 22·50.

The study of chemical evolution is based on the assumption that life appeared on the earth's surface as a result of the normal operation of physical and chemical laws. This implies that there was a period in the earth's history that encompassed the transition between non-living molecules and a population of molecular aggregates that we should call 'living'.

In this book, based on a series of lectures given in Oxford by Professor Calvin as George Eastman, Visiting Professor, two approaches are used in the attempt to determine the nature of this interface and transition. The first, molecular palæontology is the view backwards into the historical record ; the second is the construction of hypothetical chemical models that could have given rise to living organisms. Both approaches are discussed in some detail.

Botanik, Der Universitat Bonn, Bonn, West Germany, for confirming our results. We are thankful to Principal J. G. Chohan for his interest in our work. One of us (R. C. P.) thanks the University Grants Commission for financial assistance.

Department of Botany, J. A. INAMDAR.
Sardar Patel University, R. C. PATEL.
Vallabh Vidyanagar, D. C. BHATT.
Gujarat, *January* 25, 1970.

---

1. Fahn, A., *Plant Anatomy*, Pergamon Press, Oxford 1967.
2. Johansen, D. A., *Plant Microtechnique*, McGraw-Hill. Inc., New York, 1940.
3. Meeuse, A. J. D., "Plasmodesmata," *Bot. Rev.*, 1941, 7 (5), 249.
4. Uphof, J. C. Th. and Hummel, K., "Plant hairs," *Encyclopedia of Plant Anatomy*, Berlin, 1962, 4 (5)

GLYPHIUM TILLANDSIAE (CASH) ZOGG—A NEW GENUS RECORD TO INDIA

IN the course of our survey for new fungi, we encountered an interesting Ascomycete at Khandala (Poona) growing saprophytically on dead culms of *Cymbopogon martini* (Graminæ), which on critical examination was identified as a species of the hysteriaceous genus *Glyphium* Nit. ex Lehmann. The results of a detailed study of this rare fungus is presented in this note.

The name *Glyphium* was first proposed by Nitschke but validly published by his pupil Lehmann in 1886.[3] This genus is represented by three known species collected from North Africa, U.S.A., Europe and described recently by Zogg (1962). Of the three known species of this genus, *Glyphium tillandsiœ* (Cash) Zogg was described by Cash (1943) from Florida, North America (U.S.A.), as *Lophium tillandsiœ* Cash. The two other species of *Glyphium*, viz., *G. elatum* and *G. schizosporum* have been collected on 11 hosts from North Africa and Europe.

Bisby and Ellis (1952) suggested the usage of the name *Glyphium* Nit. ex Lehm. instead of *Lophium* in describing the fungus *Lophium elatum* (Greville, 1825). Zogg (1962) has followed this terminology and considered *Glyphium elatum* (= *Lophium elatum* Grev.) as the type species of the genus *Glyphium*.

Critical comparative studies revealed that the authors' collection of *Glyphium* agreed in all respects with *Glyphium tillandsiœ* (Cash) Zogg.

Glyphium tillandisœ (Cash) Zogg.

Hysterothecia in small groups, scattered, erect, orange to dark brown in colour, obovate, broader at the top, narrowed towards the base, with a depressed circular opening at the top; 330–540 μ high and 220–310 μ wide, provided with short, multicelluar dark brown hyphæ arising from the base of the ascocarp, wall cells dark brown, polygonal.

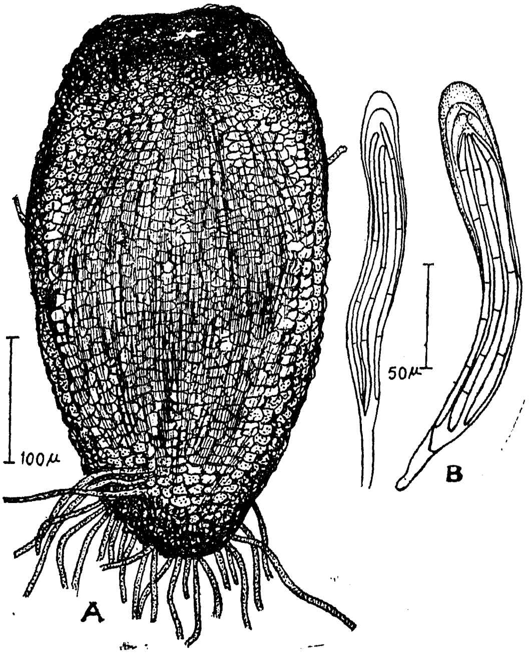


FIG. 1. A, Hysterothecium; B, Asci with ascospores

Asci linear-obclavate, bitunicate, shortly pedicellate, thickened at the apex, in basal layers; 8-spored; 210–308 × 8–11·5 μ.

Ascospores subhyaline, olivaceous, multi-septate, linear; 176–288 × 2–3 μ.

Interthecial threads numerous, filiform, sub-hyaline.

On the culms of *Cymbopogon martini* (Graminæ); Leg. P. G. Patwardhan, at Khandala (Poona) on 21st August 1969, M.A.C.S. Herb. No. 811.

The fungus is a new genus record to India and *Cymbopogon martini* a new host for the fungus. Material of this fungus is being deposited at the Herb. Crypt. Orientalis, New Delhi (India).

We are grateful to Prof. M. N. Kamat for helpful suggestions in the preparation of the manuscript and to the Director for library and laboratory facilities.

Division of Mycology and P. G. PATWARDHAN.
Plant Pathology, G. T. JOSHI.
M.A.C.S., Poona-4, *January* 25, 1970.

---

1. Bisby, G. R. and Ellis, M. B., *Trans. Brit. Mycol. Soc.*, 1952, 35, 299.
2. Cash, E. K., *Mycologia*, 1943, 35, 595.
3. Zogg, H., *Beitr. Krypt. Schwz.*, 1962, 11 (3), 190.

REVIEWS AND NOTICES OF BOOKS

Structure and Mechanism in Vinyl Polymerization. Edited by Teiji Tsuruta and Kenneth F. O'Driscoll (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 540. Price $29.50 or £14 0 *sh*. 0 *d*.

Until some twenty years ago it was necessary to proceed with the polymerization of a new vinyl monomer in a trial-and-error fashion. Fortunately the situation has improved enormously in recent years and numerous generalizations can be made which are valid for many vinyl compounds. Now, much of the comprehensive knowledge about the reactivity of vinyl compounds has been compiled in one volume. The objective of the book is to present a detailed survey of studies concerning Structure and Mechanism in Vinyl Polymerization in terms of physical organic chemistry. The reader's attention is focused on the most important chemical features of vinyl compounds and their response to variations in chemical and physical conditions. Basic concepts necessary for an understanding of the interrelation between structure and mechanism as it operates in vinyl polymerization are discussed. The various chapters pay particular attention to the elementary reactions in free radical, cationic and anionic polymerizations, and include such special topics as heterogeneous [illegible] catalysts, poly-[illegible] carbonyls, and [illegible] rearrangements in the polymerization of vinyl monomers. Both the academic and the applied polymer scientist will find the book a valuable aid.

C. V. R.

Ecological Aspects of the Mineral Nutrition of Plants. British Ecological Society Symposium Number Nine. Edited by I. H. Rorison (Blackwell Scientific Publications, Oxford and Edinburgh), 1969. Pp. xxi + 484. Price £5.

Ecologists have long been interested in the relationship between the mineral nutrition of plants and their distribution, but knowledge of basic nutritional concepts has been more vigorously advanced by specialists in other fields. At the Symposium held at Sheffield in April 1968, agronomists, physiologists, and soil chemists were brought together with ecologists to consider current knowledge of the mineral nutrition of plants and particularly of those processes by which nutritional facts influence plant distribution. Each of the 32 contributors gave an interpretation of concepts and methods from the viewpoint of his own discipline and an attempt was made to present an integrated appraisal of fundamental problems rather than a detailed study of any one ecological situation.

The volume is divided into five sections: the definitions and experimental investigation of problems in the field; a review of recent work on the properties of ions in the soil as they affect uptake by plants; evidence from experiments in which whole plants are used in investigating a limited number of factors at a physiological level, and its relevance in interpreting ecological problems; consideration of mechanisms of uptake and toxicity of ions of ecological interest studied at the tissue and cellular level; and a final section in which an ecologist, a soil chemist and physiologist give personal assessments of the major advances which have been made and the objectives which remain. An account of the discussion following each section is also included.

C. V. R.

Chemical Evolution. By Melvin Calvin. (Oxford University Press, London, and Oxford University Press, Oxford House, Mount Road, Madras-6), 1969. Pp. 278. Price 25 *sh* or Rs. 22·50.

The study of chemical evolution is based on the assumption that life appeared on the earth's surface as a result of the normal operation of physical and chemical laws. This implies that there was a period in the earth's history that encompassed the transition between non-living molecules and a population of molecular aggregates that we should call 'living'.

In this book, based on a series of lectures given in Oxford by Professor Calvin as George Eastman, Visiting Professor, two approaches are used in the attempt to determine the nature of this interface and transition. The first, molecular palæontology is the view backwards into the historical record; the second is the construction of hypothetical chemical models that could have given rise to living organisms. Both approaches are discussed in some detail.

Botanik, Der Universitat Bonn, Bonn, West Germany, for confirming our results. We are thankful to Principal J. G. Chohan for his interest in our work. One of us (R. C. P.) thanks the University Grants Commission for financial assistance.

Department of Botany, J. A. INAMDAR.
Sardar Patel University, R. C. PATEL.
Vallabh Vidyanagar, D. C. BHATT.
Gujarat, *January* 25, 1970.

---

1. Fahn, A., *Plant Anatomy*, Pergamon Press, Oxford 1967.
2. Johansen, D. A., *Plant Microtechnique*, McGraw-Hill. Inc., New York, 1940.
3. Meeuse, A. J. D., "Plasmodesmata," *Bot. Rev.*, 1941, **7** (5), 249.
4. Uphof, J. C. Th. and Hummel, K., "Plant hairs," *Encyclopedia of Plant Anatomy*, Berlin, 1962, **4** (5)

GLYPHIUM TILLANDSIAE (CASH) ZOGG—A NEW GENUS RECORD TO INDIA

IN the course of our survey for new fungi, we encountered an interesting Ascomycete at Khandala (Poona) growing saprophytically on dead culms of *Cymbopogon martini* (Graminæ), which on critical examination was identified as a species of the hysteriaceous genus *Glyphium* Nit. ex Lehmann. The results of a detailed study of this rare fungus is presented in this note.

The name *Glyphium* was first proposed by Nitschke but validly published by his pupil Lehmann in 1886.[3] This genus is represented by three known species collected from North Africa, U.S.A., Europe and described recently by Zogg (1962). Of the three known species of this genus, *Glyphium tillandsiœ* (Cash) Zogg was described by Cash (1943) from Florida, North America (U.S.A.), as *Lophium tillandsiœ* Cash. The two other species of *Glyphium*, viz., *G. elatum* and *G. schizosporum* have been collected on 11 hosts from North Africa and Europe.

Bisby and Ellis (1952) suggested the usage of the name *Glyphium* Nit. ex Lehm. instead of *Lophium* in describing the fungus *Lophium elatum* (Greville, 1825). Zogg (1962) has followed this terminology and considered *Glyphium elatum* (= *Lophium elatum* Grev.) as the type species of the genus *Glyphium*. Critical comparative studies revealed that the authors' collection of *Glyphium* agreed in all respects with *Glyphium tillandsiœ* (Cash) Zogg.

Glyphium tillandisœ (Cash) Zogg.

Hysterothecia in small groups, scattered, erect, orange to dark brown in colour, obovate, broader at the top, narrowed towards the base, with a depressed circular opening at the top; 330–540 μ high and 220–310 μ wide, provided with short, multicelluar dark brown hyphæ arising from the base of the ascocarp, wall cells dark brown, polygonal.

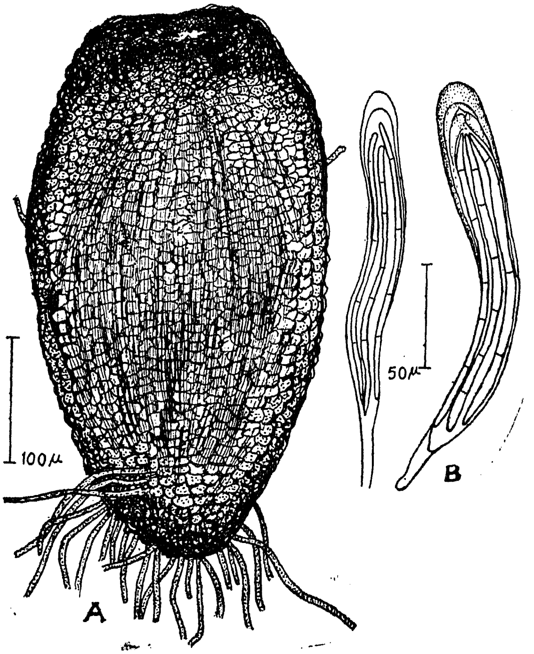


FIG. 1. A, Hysterothecium ; B, Asci with ascospores

Asci linear-obclavate, bitunicate, shortly pedicellate, thickened at the apex, in basal layers ; 8-spored ; 210–308 × 8–11·5 μ.

Ascospores subhyaline, olivaceous, multiseptate, linear ; 176–288 × 2–3 μ.

Interthecial threads numerous, filiform, subhyaline.

On the culms of *Cymbopogon martini* (Graminæ); Leg. P. G. Patwardhan, at Khandala (Poona) on 21st August 1969, M.A.C.S. Herb. No. 811.

The fungus is a new genus record to India and *Cymbopogon martini* a new host for the fungus. Material of this fungus is being deposited at the Herb. Crypt. Orientalis, New Delhi (India).

We are grateful to Prof. M. N. Kamat for helpful suggestions in the preparation of the manuscript and to the Director for library and laboratory facilities.

Division of Mycology and P. G. PATWARDHAN.
Plant Pathology, G. T. JOSHI.
M.A.C.S., Poona-4, *January* 25, 1970.

---

1. Bisby, G. R. and Ellis, M. B., *Trans. Brit. Mycol. Soc.*, 1952, **35**, 299.
2. Cash, E. K., *Mycologia*, 1943, **35**, 595.
3. Zogg, H., *Beitr. Krypt, Schwz.*, 1962, **11** (3), 190.

REVIEWS AND NOTICES OF BOOKS

Structure and Mechanism in Vinyl Polymerization. Edited by Teiji Tsuruta and Kenneth F. O'Driscoll. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 540. Price $29.50 or £14 0 *sh.* 0 *d.*

Until some twenty years ago it was necessary to proceed with the polymerization of a new vinyl monomer in a trial-and-error fashion. Fortunately, the situation has improved enormously in recent years, and numerous generalizations can be made which are valid for many vinyl compounds. Now, much of this comprehensive knowledge about the reactivity of vinyl compounds has been compiled in one source. The objective of this book is to present a general survey of studies concerning "Structure and Mechanism in Vinyl Polymerization" in terms of physical organic chemistry. The reader's attention is focused on the most important chemical features of vinyl compounds and their response to variations in chemical and physical conditions. Basic concepts necessary for an understanding of the interrelation between structure and mechanism as it operates in vinyl polymerization are discussed. The various chapters pay particular attention to the elementary reactions in free radical, cationic, and anionic polymerizations, and include such special topics as heterogeneous metal peroxides, metal alkyl catalysts, polymerization α-β-unsaturated carbonyls, and molecular rearrangements in the polymerization of vinyl monomers. Both the academic and the applied polymer scientists will find this book a valuable aid.

C. V. R.

Ecological Aspects of the Mineral Nutrition of Plants : British Ecological Society Symposium Number Nine. Edited by I. H. Rorison. (Blackwell Scientific Publications, Oxford and Edinburgh), 1969. Pp. xxi + 484. Price £5.

Ecologists have long been interested in the relationship between the mineral nutrition of plants and their distribution, but knowledge of basic nutritional concepts has been more vigorously advanced by specialists in other fields. At this Symposium held at Sheffield in April 1968, agronomists, physiologists, and soil chemists were brought together with ecologists to consider current knowledge of the mineral nutrition of plants and particularly of those processes by which nutritional facts influence plant distribution. Each of the 32 contributors gave an interpretation of concepts and methods from the viewpoint of his own discipline and an attempt was made to present an integrated appraisal of fundamental problems rather than a detailed study of any one ecological situation.

The volume is divided into five sections : the definitions and experimental investigation of problems in the field ; a review of recent work on the properties of ions in the soil as they affect uptake by plants ; evidence from experiments in which whole plants are used in investigating a limited number of factors at a physiological level, and its relevance in interpreting ecological problems ; consideration of mechanisms of uptake and toxicity of ions of ecological interest studied at the tissue and cellular level ; and a final section in which an ecologist, a soil chemist and physiologist give personal assessments of the major advances which have been made and the objectives which remain. An account of the discussion following each section is also included.

C. V. R.

Chemical Evolution. By Melvin Calvin. (Oxford University Press, London, and Oxford University Press, Oxford House, Mount Road, Madras-6), 1969. Pp. 278. Price 25 sh. or Rs. 22·50.

The study of chemical evolution is based on the assumption that life appeared on the earth's surface as a result of the normal operation of physical and chemical laws. This implies that there was a period in the earth's history that encompassed the transition between non-living molecules and a population of molecular aggregates that we should call 'living'.

In this book, based on a series of lectures given in Oxford by Professor Calvin as George Eastman, Visiting Professor, two approaches are used in the attempt to determine the nature of this interface and transition. The first, molecular palæontology is the view backwards into the historical record ; the second is the construction of hypothetical chemical models that could have given rise to living organisms. Both approaches are discussed in some detail.

The contents of this book are dealt with in three parts. Part I contains the following articles: The View from the Present Towards the Past: The Fossil Record; The Starting Materials of Molecular Palæontology; The Nature of Hydrocarbons in Micro-organisms; Molecular Palæontology. Part II contains the following articles: The View from the Past Towards the Present: Chemical Evolution; Primitive (Prebiotic) Chemistry; Selection and the Growth of Molecules; Growth of Molecules and Information Coupling; Three-Dimensional Structure and Self-Assembly; Generation of Membrane Structure. Part III contains the following articles: The View from the Present Towards the Future: The Search for Significance.

C. V. R.

Elementary Functions: **An Introduction.** By John T. Mohat. (Addison-Wesley Publishing Co., Inc., West End House, 11, Hills Place, London W. 1), 1970. Pp. 312. Price 65 *sh*.

This book is designed as a text for a one-semester course on elementary functions to pave the way for an intelligent study of calculus. The emphasis is placed on graphs as an aid to understanding functions both globally and locally. The text being strictly pre-calculus no mention is made to limits, tangents and areas. The treatment is clear and rigorous, and the division into chapters and sections is such as to be useful to teachers who can take them up in the sequence given. Each section is followed by a list of exercises and there are also problems of a more theoretical nature.

A. S. G.

ANNOUNCEMENTS

Symposium on Oils, Fats and Their Products in the Seventies

The Twenty-Sixth Annual Convention of the Oil Technologists Association of India will be held on January 16 and 17, 1971 at Vigyan Bhawan, New Delhi. A Symposium on "Oils, Fats and Their Products in the Seventies" will also be held as part of the Convention programme.

Those who wish to contribute technical papers and take part in the deliberations of the Symposium, should write to Shri S. S. Ramaswamy, Convener, Deputy General Manager, D.C.M. Chemical Works, New Delhi-15.

Symposium on Biological Aspects of Electrochemistry, Rome, Italy

The Symposium on Biological Aspects of Electrochemistry of CITCE will be held in Rome, Italy, from 31st May to 4th June 1971.

Main themes: Biological Activity and Electrochemical Properties; Thermodynamics of Organic Redox System of Biological Interest; Electrochemical Kinetics of Organic Redox Systems of Biological Interest; Electrochemical Membrane Phenomena.

For further information please apply to: Dr. H. Tannenberger, Secretary-General of CITCE, Battelle Institute, 7 route de Drize, 1227 Carouge-Geneve, Switzerland, or Prof. G. Milazzo, Instituto Superiore di Sanita, Viale Regina Elena 299, 00161 Roma, Italy.

Lady Tata Memorial Trust-Scholarships and Grants for the Year 1970-71

The Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1970, the awards of scholarships and grants for the year 1970-71.

International Awards of varying amounts (totalling £ 12,975) for research in diseases of the blood with special reference to leukæmias are made to: 1. Dr. O. Mach (Czechoslovakia), 2. Dr. P. Stryckmans (Belgium), 3. Dr. Jean-Francois Dore (France), 4. Dr. E. Dvorak (Czechoslovakia), 5. Dr. Yves Najean (France), 6. Dr. T. M. Dexter (Great Britain), 7. Dr. (Mrs.) M. H. Panthaki (India), 8. Dr. D. J, Reen (Ireland), 9. Dr. G. B. Rossi (Italy), 10. Dr. T. J. E. Rytomaa (Finland), 11. Dr. B. Szafarz (Belgium).

Senior Indian Scholarships of Rs. 500 p.m. each and Junior Scholarships of Rs. 300 p.m. each for one year for scientific investigations having a bearing on the alleviation of human sufferings from disease are awarded to: *Senior Scholarships*: 1. Mr. S. K. Mishra (Delhi), 2. Mr. R. Nayak (Bangalore). *Junior Scholarships*: 1. Miss M. Bannerjee (Calcutta), 2. Mr. D. S. Khaire (Bombay), 3. Mr. M. A, Siddiqi (Aligarh), 4. Miss A. Bhandarkar (Bangalore), 5. Dr. R. C. Dash (Berhampur), 6. Mr. N. V. Nanda Kumar (Tirupati), 7. Miss D. J. Mirza (Bombay), 8. Dr. (Mrs.) M. A. Phadke (Poona), 9. Mr. M. Saleemuddin (Aligrah), 10. Miss P. Sorabji (Allahabad).

2170-70 Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed
by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

EFFECT OF MICRO-ADDITION OF MAGNESIUM ON SIDE-BAND FORMATION IN ALUMINIUM-ZINC ALLOYS

K. G. SATYANARAYANA, R. P. WAHI AND T. R. ANANTHARAMAN

Department of Metallurgy, Institute of Technology, Banaras Hindu University, Varanasi-5

ABSTRACT

The effect of micro-addition of magnesium on the decomposition characteristics of an Al-30 at.% Zn alloy has been investigated with the help of X-ray diffraction and hardness measurements. The ternary alloy has been found to develop side bands after very long ageing at room temperature. The results have been explained on the basis of Cahn's theory of spinodal decomposition.

INTRODUCTION

It has been known for more than two decades that some solid solution alloys exhibit special X-ray diffraction effects in the early stages of their decomposition into two phases.[1] The effect consists in the appearance of diffuse reflections, commonly known as 'side bands' on either side of the matrix Debye-Scherrer reflections. Such alloys in fact have come to be known as 'side-band alloys'.[2] Among the various models proposed to explain this phenomenon in terms of the structure of these alloys, the one proposed many years ago by Daniel and Lipson,[1] suggesting a sinusoidal variation in composition of the alloy in three dimensions having a characteristic wavelength (λ), has been supported by the recent theoretical studies of Hillert,[3,4] Cahn and Hilliard[5,6] and Cahn.[7-10]

According to Cahn's theory of 'spinodal transformation', an alloy whose composition lies between the inflection or spinodal points of chemical free energy *versus* composition curve for the alloy system (*i.e.*, points at which $\partial^2F/\partial^2C = 0$) tends to decompose spontaneously into solute-depleted and solute-rich regions, giving rise to a sinusoidal variation in its composition from the mean value. It has also been shown by Cahn[7,10] that because of the continuous variation in its composition in space, the alloy is elastically strained during this transformation. The elastic strain free energy associated with the alloy may then effectively stabilize it against any such composition variation until the driving force for the transformation is increased to balance the same. In other words, a certain minimum degree of under-cooling below the spinodal point is necessary before the alloy can undergo the spinodal transformation. A review of recent experimental work on side-band alloys in the light of Cahn's theory has recently been made by Wahi and Anantharaman.[11]

Considerable interest has naturally been aroused in recent times in the study of this mode of transformation. Apart from the theoretical interest, there is the expectation that this type of transformation will result in a significant improvement in properties like hardness, strength, resistance to grain boundary corrosion and particle coarsening as well as in the development of the property of superplasticity in such alloys.

Experimental work confirming the existence of a spinodal transformation in Al-Zn alloys has been conducted by a number of investigators.[12-15] There has, however, been some discrepancy in the results. Rundman and Hilliard[12] have reported, on the basis of small-angle X-ray scattering measurements, a decomposition wavelength of 40 Å in a 22 at.% Zn alloy transformed at 60° C. Wahi and Anantharaman[13] could not, however, detect side bands in a similar alloy at any temperature below 140° C. Douglass and Barbee[14] have reported a wavelength of 100–300 Å in alloys containing 15–40 at.% Zn on transformation at room temperature and 100° C. Nuttal and Nicholson[15] have shown that such a transformation occurs only in alloys of eutectoid composition, *i.e.*, 60 at.% Zn.

The present investigations, which form part of a detailed programme of study on precipitation hardening in aluminium alloys are concerned with the influence of trace additions of magnesium (0·35 at.%) on the decomposition kinetics and side-band formation in an Al-30 at.% Zn alloy. It is relevant to recall in this connection that magnesium has been known to have a remarkable influence[16-19] on the precipitation kinetics in Al-Zn alloys and that the strongest commercial aluminium alloys are based on the Al-Zn-Mg ternary system. An attempt is also made here to explain the absence of side bands in Debye-Scherrer patterns of high purity binary Al-Zn alloys transformed below 140° C.[13]

EXPERIMENTAL PROCEDURE

Alloy Preparation.—The binary and ternary alloys were prepared from super-purity aluminium (99·999 + %) and high-purity B.D.H. zinc (99·99 + %) and magnesium (99·99 + %). Weighed quantities of aluminium were melted in a graphite crucible in an electric furnace. Required amounts of zinc or magnesium and zinc wrapped separately in aluminium foils were added to liquid aluminium. Each alloy was kept molten for 15–20 mins. at 750° C. for homogenization before pouring into cylindrical graphite moulds of 2 cm. inside dia. and 10 cm. length. The ingots were hot-forged to 0·5 cm. thick plates which were then homogenized and stress-relieved at 300° C. for 3 days. For hardness measurements, samples of 2 × 1 × 0·5 cm. were cut from the sheets. A strip was cut from the forged sheet of each alloy and rolled in several stages, with intermediate annealing at 300° C. to thin rods of 2–3 mm. dia. These were finally hot-drawn to wires of 0·25 mm. dia. for X-ray diffraction work. A careful chemical analysis showed the alloys to be within ± 0·2 at.% of the desired zinc content. No chemical analysis for magnesium content was done. However, since loss in weight of the alloy after casting was negligible, all the added magnesium was assumed to be present in the alloy.

Heat Treatment and Hardness Measurement.—The bulk specimens as well as the wire samples were solution-treated at 380° C. for one hour in an electric muffle furnace controlled to ± 2° C. and then quenched in water. Ageing treatment was carried out at room temperature (~ 30° C.).

Hardness values were determined on a Vickers Pyramid Hardness Testing Machine using a load of 5 kg., an average of 5 readings on each specimen constituting a single measurement.

X-ray Diffraction Experiments.—The wire samples were subjected to X-ray examination after the above-referred quenching and ageing treatments. An 11·4 cm. dia. Debye-Scherrer camera and nickel filtered CuK$_\alpha$ radiation from a Philips X-ray Generator were employed, with an average exposure time of 1½ hr. at 35 kV and 15 mA. Some X-ray investigation was also carried out, in a Philips (PW 1051) Diffractometer, on bulk specimens heat-treated to show side band effects.

EXPERIMENTAL RESULTS

Figure 1 shows the room temperature (~ 30° C.) ageing curves of the binary alloy, *viz.*, Al-30 at.% Zn alloy and the ternary alloy, *viz.*, Al-30 at.% Zn alloy containing 0·35 at.% Mg. The following important points are obvious :

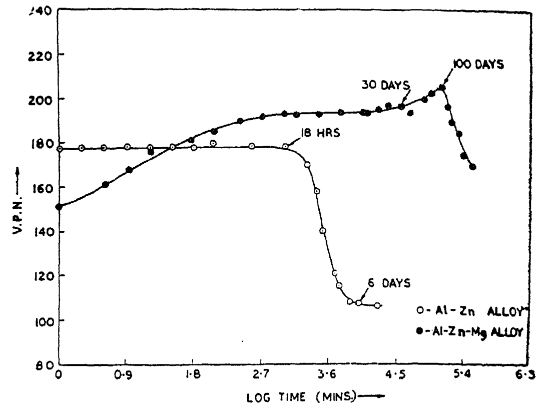


FIG. 1. Room temperature ageing curves of Al-30 at.% Zn and Al–30 at.% Zn + 0·35 at.% Mg alloys after quenching from 380° C.

The Ternary Alloy.—(*i*) The hardness of the ternary alloy increases rapidly from the as-quenched value of 150 VPN to a peak value of 190 VPN in about 24 hours. (*ii*) A second but much slower increase in hardness is observed in the ternary alloy after 24 hours for a period of 15 days. (*iii*) The hardness of the ternary alloy finally decreases slowly from the second peak value of 205 VPN.

The Binary Alloy.—The binary alloy, on the other hand, does not show any initial rapid increase in hardness. Instead, the hardness remains constant at as-quenched value of 178 VPN upto 18 hours and then falls continuously to a very low value of 105 VPN in 6 days.

The X-ray diffraction patterns taken at regular time intervals revealed the following features :

The Ternary Alloy.—(*i*) Reflections corresponding to f.c.c. matrix only were present for ageing times upto 4 days. (*ii*) Some faint zinc reflections appeared after about 5 days and increased both in number and intensity over a period of several days of ageing. (*iii*) Very faint side bands appeared after about 30 days of ageing and continued to be present for about 120 days. Since the bands were very faint their photographic reproduction was not easy. A schematic representation of a typical Debye-Scherre pattern showing side bands is shown in Fig. 2. A diffractometric record of a bulk sample heat-treated to develop side bands is shown in Fig. 3. The thick curve shows the (200) diffraction peak from the matrix with a broad, small peak (side band) on either side. The thin curve shows the position of the (200) peak before the appearance of side bands, *i.e.*, for ageing periods of less than 30 days. (*iv*) Matrix lattice parameter remained unchanged upto about 30 days after which it showed a gradual increase.

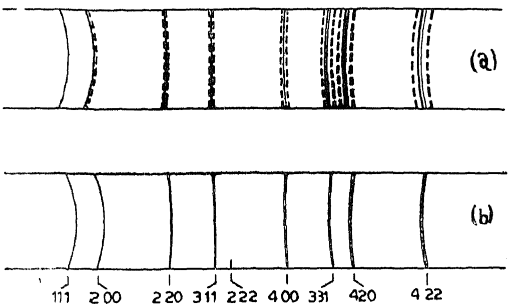


FIG. 2. A schematic representation of typical Debye Scherrer patterns : (*a*) with and (*b*) without side bands (- - -).

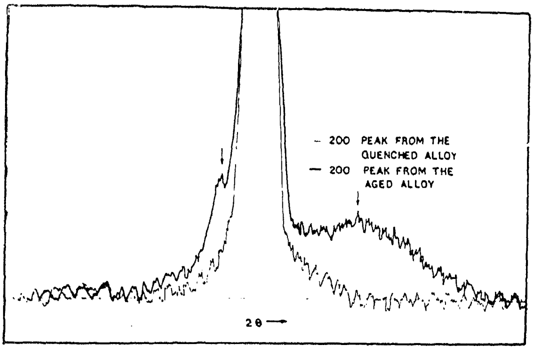


FIG. 3. Superimposition of diffractometric records from the bulk sample of the ternary alloy in the as-quenched (thin curve) and aged (thick curve) conditions. The positions of the side-band peaks are indicated by arrows.

The Binary Alloy.—(*i*) Reflections corresponding to the f.c.c. zinc-rich matrix only were present for ageing times upto about 4-5 hours.

(*ii*) A few faint zinc reflections appeared between 6-18 hours of ageing.

(*iii*) Many intense zinc reflections made their appearance at time interval corresponding to the start of hardness fall in the corresponding hardness curve (Fig. 1).

(*iv*) No side bands were detected at any stage of ageing in the binary alloy.

DISCUSSION

It has been shown by Cahn[20] that the strength of a spinodally decomposed alloy is proportional to the wavelength of the transforming structure. For each transformation temperature, there is a characteristic wavelength which decreases with increasing undercooling and solute concentration. Once the transformation is complete, a process of competitive growth of the characteristic wavelength sets in to reduce the interfacial energy between the solute-rich and solute-depleted regions. This process is controlled by diffusion. In concentrated Al-Zn alloys, quenched from a high temperature to room temperature, the diffusion coefficient has been shown[12] to fall to the extremely low equilibrium value within 1-2 mins. of quenching. In such a case, the growth of the decomposition wavelength is expected to be negligible at room temperature. Hence the hardness, according to Cahn's model,[20] should remain constant. Further, because of the relatively fast diffusion rate of aluminium and zinc atoms in binary Al-Zn alloys and so a faster rate of spinodal transformation, the quenched alloy at room temperature may not have a single characteristic decomposition wavelength, but a spectrum of wavelengths formed at various higher temperatures during quenching. The hardness of such an alloy would, therefore, be proportional to an average wavelength which will be larger than the wavelength characteristic of room temperature. The ageing curve of the binary alloy shown in Fig. 1 is in accordance with the above reasoning.

The existence of a spinodal structure of extremely small wavelengths (40–100 Å) is also the reason why side bands could not at all be detected by Wahi and Anantharaman[13] in the Debye-Scherrer patterns of an Al-30 at.% Zn alloy aged at and around room temperature. Solute-rich and solute-depleted regions of the size of the orders of 20–50 Å cannot be expected to give rise to significant diffraction effects in Debye-Scherrer patterns.

The presence of an element like magnesium with a large binding energy[18,19] with vacancies is expected to have the following effects on vacancy distribution and migration in the ternary alloy :

(*i*) A large fraction of vacancies will be tied up with magnesium atoms in the form of Mg-Vac couples,[19] with the result that the rate of spinodal decomposition, which depends on the diffusion of aluminium and zinc, will be slower.

(*ii*) The fraction of excess vacancies associated with magnesium atoms will remain in solution for a long time in the form of mobile Mag-Vac couples.[19] Presence of such couples, which are, however, much less mobile than single vacancies, may be expected to cause a slow but steady and continuous growth of decomposition wavelength at room temperature.

It follows from the above argument that the ternary alloy will have a lower as-quenched hardness since only a negligible spinodal decomposition is likely to take place in it during the process of quenching. The average decomposition wavelength at room temperature immediately after quenching will then be nearer to that characteristic of room temperature and hence smaller as compared to that in the binary alloy. Because of the presence of some excess vacancies in the form of mobile Mag-Vac couples, the diffusion coefficient of zinc atoms will, however, remain a little higher than the equilibrium room temperature value for a much longer time, resulting in a continued competitive growth of the wavelength. This has been confirmed in the present work by the appearance of side bands in the ternary alloy after 30 days of ageing at room temperature. For the same reason, *i.e.*, the continued growth of the decomposition wavelength over a period of several days the peak hardness of the ternary alloy is expected to be higher than that of the binary alloy.

One point which is very interesting and for which we are unable to offer proper explanation at present, is the much larger incubation period for the precipitation of zinc and, therefore, much longer time over which hardness remains constant at a high value in the ternary alloy than in the binary alloy. This appears to be associated with the difficulty in the nucleation of zinc in the ternary alloy. Although no definite reason can be given at present for such a behaviour, it may be related to a change in the equilibrium structure of the alloy with the addition of magnesium. According to the ternary Al-Zn-Mg equilibrium diagram,[21] the present ternary alloy lies in the phase region having the α-solid solution, zinc and $MgZn_2$ in equilibrium. Such a change in equilibrium state from a two-phase to a three-phase equilibrium is expected to change the solid solubility limit of zinc in aluminium. If the limit is extended to higher zinc content the ternary alloy will be less supersaturated with respect to zinc as compared to the binary alloy and therefore the kinetics of zinc precipitation in it will be slower.

ACKNOWLEDGMENT

One of the authors (K. G. Satyanarayana) wishes to thank the University Grants Commission, New Delhi, for the award of a Junior Research Fellowship.

---

1. Daniel, V. and Lipson, H., *Proc. Roy. Soc.*, **1948**, **152 A**, 575.
2. Kelly, A. and Nicholson, R. B., *Progress in Material Science* 1963, **10**, 158.
3. Hillert, M., *Sc.D. Thesis*, Massachusetts Institute of Technology, 1956.
4. —, *Acta Met.*, 1961, **9**, 525.
5. Cahn, J. W. and Hilliard E., *J. Chem. Phys.*, 1957, **28**, 258.
6. and , *Ibid.*, 1959, **31**, 688.
7. Cahn, J. W., *Acta Met.*, 1961, **9**, 795.
8. , *Ibid.*, 1962, **10**, 179.
9. , *Ibid.*, 1962, **10**, 907.
10. , *Trans. AIME*, 1968, **242**, 166.
11. Wahi, R. P. and Anantharaman, T. R., *Material Science Research Symposium*, Bangalore, 1970.
12. Rundman, K. B. and Hilliard, J. E., *Acta Met.*, 1967, **15**, 1025.
13. Wahi, R. P. and Anantharaman, T. R., *Scripta Met.*, 1968, **2**, 681.
14. Douglass, D. L. and Barber, T. W., *J. Mater. Sci.*, 1969, **4**, 130.
15. Nuttal, K. and Nicholson, R. B., *Phil. Mag.*, 1968, **17**, 1087.
16. Polmear, I. J., *J. Inst. Metals*, 1957, **86**, 113.
17. Gould, R. W., *Advances in X-ray Analysis*, 1967, **10**, 188.
18. Wahi, R. P., Rao, V. V. P. K. and Anantharaman, T. R., *Indian J. Tech.*, 1968, **6**, 8.
19. Panseri, C. and Federighi, T., *Acta Met.*, 1963, **11**, 575.
20. Cahn, J. W., *Ibid.*, 1966, **14**, 83.
21. Kolobnev, I. F., *Heat Treatment of Aluminium Alloys*, Israel Program for Scientific Translation, Jerusalem, 1963, p. 121.

NATURE OF PALAEOCURRENTS IN THE CENTRAL PART OF THE VINDHYAN BASIN

B. DAS,* G. N. SAXENA,* S. S. ATWAL,** AND S. U. KHAN*

INTRODUCTION

PALAEOCURRENT analysis is one of the major tools for working out the process and direction of transport of sediments, orientation of the basin of deposition, and the palæogeographical history of the rock units. Until the work of Banerjee and Sen Gupta (1963) this tool was neglected in the study of the Vindhyan Group, although throughout its 5,000 metres there is a variety of directional sedimentary structures. The present note is confined to the study of palæocurrent systems deducted from cross-stratification measurements in the Semri Series in Chattarpur District (M.P.), in the Kaimur Series around Gwalior, and in the Rewa Series around Sagar and Jhansi-Sagar Road.

TECHNIQUE

Trough cross-bedding, with concave foresets, is the normal type: planar cross-bedding is not uncommon. A succession of co-sets occurs in each section. In each co-set an azimuthal measurement was made of the maximum fore-set dip, an allowance having been made for the regional dip.

Compass-diagrams (Tanner, 1959) have been found to be more useful than the conventional rose-diagrams. The compass is divided into twelve sectors, each comprising an arc of 30 degrees. The mean of the number of measurements per sector and the standard deviation of the number of measurements per sector are calculated. If the measurements in any one sector exceed the mean *plus* the standard deviation, that sector is said to exhibit a major mode. Sectors whose measurements are below the mean *less* the standard deviation represent nodes.

PALAEOCURRENT PATTERNS

1. *Semri Series.*—The compass-diagram for 25 cross-bedding directions measured in the Semri Series exposed in the Chattarpur District (south of Bijawar) shows two modes, one north-west, one south-east (Fig. 1). These two mutually opposed modes can possibly be attributed to the fluvial currents towards the sea and on-shore directed marine currents, the fluvial currents being dominant. The stratigraphic and sedimentological studies necessary to prove this are lacking. Nevertheless, the geographical distribution of the Semri Series, coupled with the palæocurrent pattern, point to a north-east south-west orientation of the shore-line in this region, with the land source lying to the north-west. Selley (1967) noted two mutually opposed modes related to fluvial and marine currents, perpendicular to the shore-line, in the Miocene rocks of Libya.

2. *Kaimur Series.*—56 cross-bedding directions were measured on outcrops of the Kaimur Series around Gwalior. The compass-diagram (Fig. 2) shows a north-north-east and a west-south-west mode. Two minor modes in the east-south-east and the south-south-west are also noteworthy, and although these lie within one standard deviation of the mean, the occurrences in the adjacent sectors are relatively insignificant. This bi-modal palæocurrent pattern with secondary modes can possibly be related to the divergencies of the regional drainage; a varying wind direction cannot be ruled out. As in the Semri Series, there are no other sedimentological studies to test this.

3. *Rewa Series.*—From 44 cross-bedding azimuths in the Rewa Series around the Jhansi-Sagar Road, a north-west and a south-west mode are found (Fig. 3). A secondary south-east mode is also present. 72 cross-bedding azimuths were also recorded in the same series around Sagar, and a compass-diagram of them (Fig. 4) shows two north-west modes and a south-west mode. The rose-diagram for the same 72 cross-bedding measurements (Fig. 5) (given here for comparison with the compass-diagram), gave an azimuthal mean of 274 degrees. The significance of the mean in such a case is probably questionable. Moreover, the inadequate sampling and grouping of the data of a thick rock unit may make interpretation difficult and obscure the real palæocurrent pattern. The palæocurrent pattern around Sagar might be attributed to a pro-delta platform or a meandering stream system, and the Jhansi-Sagar Road pattern to a strongly meandering river, but the sedimentological

---

* Centre of Advanced Study in Geology, University of Saugar, India.

** Department of Geology, University of London, King's College, England.

(*ii*) The fraction of excess vacancies associated with magnesium atoms will remain in solution for a long time in the form of mobile Mag-Vac couples.[19] Presence of such couples, which are, however, much less mobile than single vacancies, may be expected to cause a slow but steady and continuous growth of decomposition wavelength at room temperature.

It follows from the above argument that the ternary alloy will have a lower as-quenched hardness since only a negligible spinodal decomposition is likely to take place in it during the process of quenching. The average decomposition wavelength at room temperature immediately after quenching will then be nearer to that characteristic of room temperature and hence smaller as compared to that in the binary alloy. Because of the presence of some excess vacancies in the form of mobile Mag-Vac couples, the diffusion coefficient of zinc atoms will, however, remain a little higher than the equilibrium room temperature value for a much longer time, resulting in a continued competitive growth of the wavelength. This has been confirmed in the present work by the appearance of side bands in the ternary alloy after 30 days of ageing at room temperature. For the same reason, *i.e.*, the continued growth of the decomposition wavelength over a period of several days the peak hardness of the ternary alloy is expected to be higher than that of the binary alloy.

One point which is very interesting and for which we are unable to offer proper explanation at present, is the much larger incubation period for the precipitation of zinc and, therefore, much longer time over which hardness remains constant at a high value in the ternary alloy than in the binary alloy. This appears to be associated with the difficulty in the nucleation of zinc in the ternary alloy. Although no definite reason can be given at present for such a behaviour, it may be related to a change in the equilibrium structure of the alloy with the addition of magnesium. According to the ternary Al-Zn-Mg equilibrium diagram,[21] the present ternary alloy lies in the phase region having the α-solid solution, zinc and $MgZn_5$ in equilibrium. Such a change in equilibrium state from a two-phase to a three-phase equilibrium is expected to change the solid solubility limit of zinc in aluminium. If the limit is extended to higher zinc content the ternary alloy will be less supersaturated with respect to zinc as compared to the binary alloy and therefore the kinetics of zinc precipitation in it will be slower.

ACKNOWLEDGMENT

One of the authors (K. G. Satyanarayana) wishes to thank the University Grants Commission, New Delhi, for the award of a Junior Research Fellowship.

---

1. Daniel. V. and Lipson, H., *Proc. Roy. Soc.*, 1948, **152 A,** 575.
2. Kelly, A. and Nicholson, R. B., *Progress in Material Science*. 1963, **10,** 158.
3. Hillert, M., *Sc.D. Thesis*, Massachusetts Institute of Technology, 1956.
4. —, *Acta Met.*, 1961, **9,** 525.
5. Cahn, J. W. and Hilliard E., *J. Chem. Phys.*, 1957, **28,** 258.
6. — and —, *Ibid.*, 1959, **31,** 688.
7. Cahn, J W., *Acta Met.*, 1961, **9,** 795.
8. —, *Ibid.*, 1962, **10,** 179.
9. —, *Ibid.*, 1962. **10,** 907.
10. —, *Trans. AIME*, 1968, **242,** 166.
11. Wahi, R. P. and Anantharaman, T. R., *Material Science Research Symposium*, Bangalore, 1970.
12. Rundman, K. B. and Hilliard, J. E., *Acta Met.*, 1967, **15,** 1025.
13. Wahi, R. P. and Anantharaman, T. R., *Scripta Met.*, 1968, **2,** 681.
14. Douglass, D. L. and Barbee, T. W.. *J. Mater. Sci.*, 1969, **4,** 130.
15. Nuttal. K. and Nicholson, R. B., *Phil. Mag.*, 1968, **17,** 1087.
16. Polmear, I. J., *J. Inst. Metals*, 1957, **86,** 113.
17. Gould, R. W., *Advances in X-ray Analysis*, 1967, **10,** 185.
18. Wahi, R. P., Rao, V. V. P. K. and Anantharaman, T. R., *Indian J. Tech.*. 1968, **6,** 8.
19. Panseri, C. and Federighi, T., *Acta Met.*, 1963, **11,** 575.
20. Cahn, J W., *Ibid.*, 1966, **14,** 83.
21. Kolohnev, I. F., *Heat Treatment of Aluminium Alloys*, Israel Program for Scientific Translation, Jerusalem, 1963, p. 121.

NATURE OF PALAEOCURRENTS IN THE CENTRAL PART OF THE VINDHYAN BASIN

B. DAS,* G. N. SAXENA,* S. S. ATWAL,** AND S. U. KHAN*

INTRODUCTION

PALAEOCURRENT analysis is one of the major tools for working out the process and direction of transport of sediments, orientation of the basin of deposition, and the palæogeographical history of the rock units. Until the work of Banerjee and Sen Gupta (1963) this tool was neglected in the study of the Vindhyan Group, although throughout its 5,000 metres there is a variety of directional sedimentary structures. The present note is confined to the study of palæocurrent systems deducted from cross-stratification measurements in the Semri Series in Chattarpur District (M.P.), in the Kaimur Series around Gwalior, and in the Rewa Series around Sagar and Jhansi-Sagar Road.

TECHNIQUE

Trough cross-bedding, with concave fore-sets, is the normal type: planar cross-bedding is not uncommon. A succession of co-sets occurs in each section. In each co-set an azimuthal measurement was made of the maximum fore-set dip, an allowance having been made for the regional dip.

Compass-diagrams (Tanner, 1959) have been found to be more useful than the conventional rose-diagrams. The compass is divided into twelve sectors, each comprising an arc of 30 degrees. The mean of the number of measurements per sector and the standard deviation of the number of measurements per sector are calculated. If the measurements in any one sector exceed the mean *plus* the standard deviation, that sector is said to exhibit a major mode. Sectors whose measurements are below the mean *less* the standard deviation represent nodes.

PALAEOCURRENT PATTERNS

1. *Semri Series.*—The compass-diagram for 25 cross-bedding directions measured in the Semri Series exposed in the Chattarpur District (south of Bijawar) shows two modes, one north-west, one south-east (Fig. 1). These two mutually opposed modes can possibly be attributed to the fluvial currents towards the sea and on-shore directed marine currents, the fluvial currents being dominant. The stratigraphic and sedimentological studies necessary to prove this are lacking. Nevertheless, the geographical distribution of the Semri Series, coupled with the palæocurrent pattern, point to a north-east south-west orientation of the shore-line in this region, with the land source lying to the north-west. Selley (1967) noted two mutually opposed modes related to fluvial and marine currents, perpendicular to the shore-line, in the Miocene rocks of Libya.

2. *Kaimur Series.*—56 cross-bedding directions were measured on outcrops of the Kaimur Series around Gwalior. The compass-diagram (Fig. 2) shows a north-north-east and a west-south-west mode. Two minor modes in the east-south-east and the south-south-west are also noteworthy, and although these lie within one standard deviation of the mean, the occurrences in the adjacent sectors are relatively insignificant. This bi-modal palæocurrent pattern with secondary modes can possibly be related to the divergencies of the regional drainage; a varying wind direction cannot be ruled out. As in the Semri Series, there are no other sedimentological studies to test this.

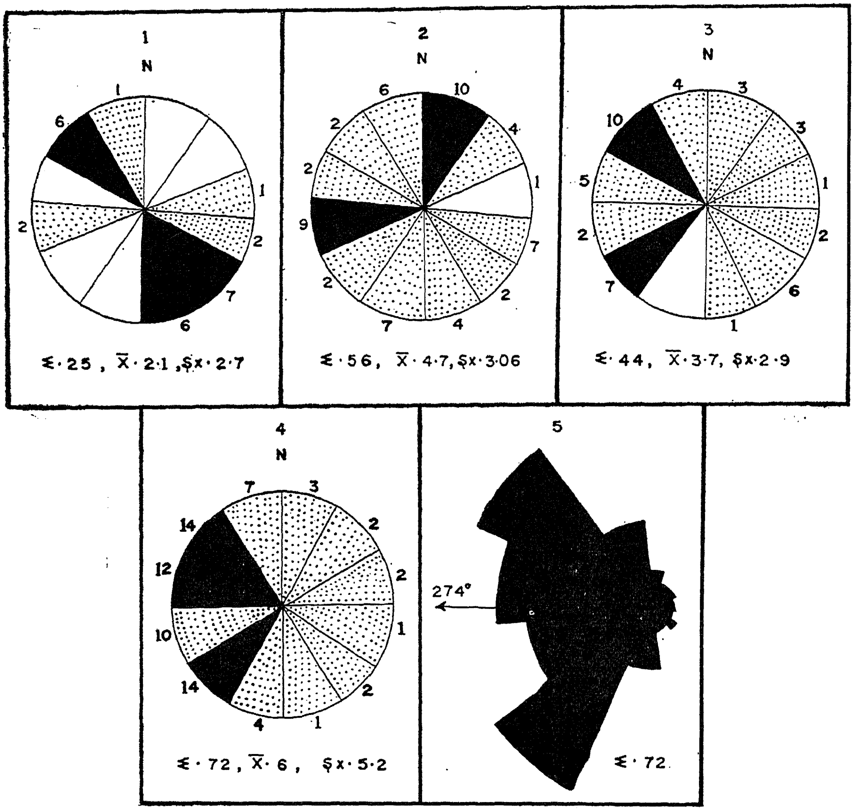
3. *Rewa Series.*—From 44 cross-bedding azimuths in the Rewa Series around the Jhansi-Sagar Road, a north-west and a south-west mode are found (Fig. 3). A secondary south-east mode is also present. 72 cross-bedding azimuths were also recorded in the same series around Sagar, and a compass-diagram of them (Fig. 4) shows two north-west modes and a south-west mode. The rose-diagram for the same 72 cross-bedding measurements (Fig. 5) (given here for comparison with the compass-diagram), gave an azimuthal mean of 274 degrees. The significance of the mean in such a case is probably questionable. Moreover, the inadequate sampling and grouping of the data of a thick rock unit may make interpretation difficult and obscure the real palæocurrent pattern. The palæocurrent pattern around Sagar might be attributed to a pro-delta platform or a meandering stream system, and the Jhansi-Sagar Road pattern to a strongly meandering river, but the sedimentological

---

* Centre of Advanced Study in Geology, University of Saugar, India.

** Department of Geology, University of London, King's College, England.

studies to substantiate this view are lacking. A poly-modal palæocurrent pattern in the Pocono formation of Pennsylvania was noted by Pelletier (1958) and he attributed it to the divergencies of the stream system.



FIGS. 1–5. Compass-diagrams presenting number of measurements per 30° sector. Modes shown by shaded sectors. Sectors within one standard deviation of the mean are stippled and sectors below the difference of mean and standard deviation are left blank. Fig. 1. Compass-diagram for Semri Series in Chattarpur District. Fig. 2. Compass-diagram for Kaimur Series around Gwalior. Fig. 3. Compass-diagram for Rewa Series around Jhansi-Sagar Road. Fig. 4. Compass-diagram for Rewa Series around Sagar. Fig. 5. Rose-diagram for Rewa Series around Sagar.

On the basis of the data presented in this note and an analysis of the data of Mishra (1967) on the south-western part of the basin, and of Jafar *et al.* (1966) for Fatehpur Sikri (Agra), it is evident that the provenance shifted from the north-west during Semri deposition towards an east to south-west range of directions during the Upper Vindhyan, although the data are still not sufficient to be certain. If true, the orientation and the position of the basin must also have changed.

ACKNOWLEDGEMENTS

The authors are greatly indebted to J. M. Hancock, King's College, University of London, for reading the manuscript and offering suggestions for its improvement. They also wish to extend their gratitude to R. C. Selley, Imperial College and H. C. Potter, King's College, London, for constructive suggestions.

---

1. Banerjee, I. and Sen Gupta, S., *Quart. Jour. Geol. Min. Met. Soc. India*, 1963, **35** (2).
2. Jafar, S. A., Akhtar, K. and Shrivastava, V. K., *Bull. Geol. Soc. Ind.*, 1966, **3**, 82.
3. Mishra, S. K., *Curr. Sci.*, 1967, p. 21.
4. Pelletier, B. R., *Geol. Soc. Amer. Bull.*, 1958, p. 69.
5. Selley, R. C., *Jour. Geol.*, 1967, p. 75.
6. Tanner, W. F., *Jour. Sed. Petrol.*, 1959, **29** (2).

INTERACTION BETWEEN GIBBERELLIC ACID AND INDOLE ACETIC ACID

H. A. FODA, M. E. YOUNIS AND A. S. El-GOBASHY
[illegible] Faculty of Science, A'in Shams University, Abbassia, Cairo, U.A.R.

INTRODUCTION

GIBBERELLINS are now considered to represent a group of plant hormones with an action clearly distinguished from that of auxin. Treatment of a variety of plants with gibberellic acid (GA) was found to increase the [illegible] growth [illegible] relation was directly proportional to the dose of applied GA (see Audus, [illegible]; [illegible], 1964; Devlin, 1966).

Recently [illegible] (1969) found that GA [illegible] increased stem height, number of leaves, fresh and dry weight of [illegible] *communis*. The [illegible] GA treated plants [illegible] increase in stem thickness [illegible]. In the case of [illegible] an inhibition of root growth was observed in GA treated seedlings.

The same author also found that stem apices of GA treated [illegible] plants had more extractable GA [illegible] than those of the untreated plants especially at the early stages of [illegible]. The activity level of [illegible] was found to be proportional to the concentration of the applied GA.

The following experiments were carried out to [illegible] interaction between GA and [illegible] (IAA), using the [illegible] of soybean and *Ricinus* [illegible].

MATERIALS

The test objects used in the present work were the hypocotyls and radicle of soybean and *Ricinus* [illegible]. The seeds of the two plants were kindly [illegible] by the Ministry of Agriculture of U.A.R.

Seeds of *Ricinus* and soybean were germinated on moistened cotton wool in large petri dishes in a dark room at about 30° C. Sections from uniform hypocotyls and radicles were excised from *Ricinus* seedlings when they were 6 days old and from soybean seedlings when they were 4 days old. The sections were excised from the upper meristematic part of the hypocotyls and from the meristematic zone of radicles next to the root tips.

EXPERIMENT I

Interation between GA at a Constant Concentration and IAA at Different Concentrations

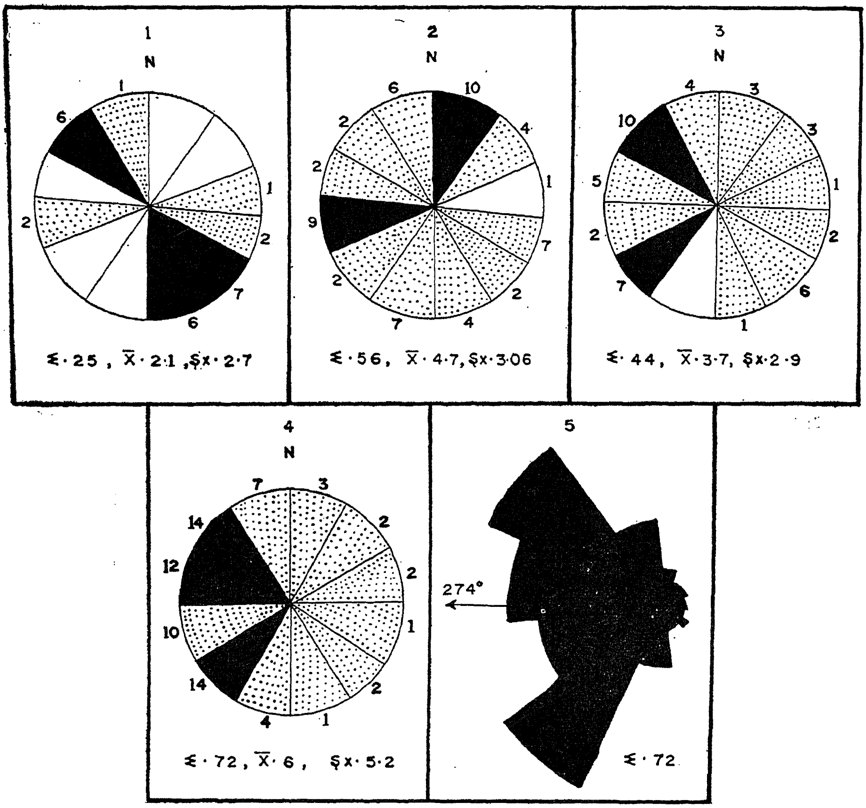
Method.—A set of 9 solutions containing a constant concentration of GA and different dilutions of IAA (10^3, 10^2, 10^1, 10^0, 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4} and 10^{-5} ppm) was prepared. The concentration of GA used was the optimum concentration for the growth of the test plants. Thus, it has been found in a preliminary experiment that the optimum concentration of GA for the growth of *Ricinus* hypocotyl sections was 10 ppm, while it was 1 ppm in the case of soybean hypocotyl segments. With regard to the optimum concentration of GA for the root growth, it was found to be 10^{-1} ppm in the case of *Ricinus* and 10^{-2} ppm for soybean.

A control set of IAA at the same concentrations, just mentioned above, was also prepared in the absence of GA.

The activities of the different solutions of the 2 sets, in the presence and absence of GA, were assayed using hypocotyl and radicle sections of *Ricinus* and soybean seedlings. At the same time, control dishes of distilled water were also bioassayed.

The growth of hypocotyl and radicle sections, expressed as percentage of the control, was plotted against the concentration of IAA. The results are shown in Fig. 1 for *Ricinus* and in Fig. 2 for soybean.

Results.—When IAA was used alone, its relatively high concentrations inhibited the straight growth of the hypocotyl and radicle sections of the two plants under investigation. By further dilutions of IAA, the growth of the hypocotyl and radicle sections was gradually stimulated, reached a maximum value at an optimum concentration and then decreased at lower dilutions of IAA (*see* Figs. 1 and 2). The optimum concentration of IAA for the growth of *Ricinus* hypocotyls was 1 ppm while it was 10^{-1} ppm for soybean hypocotyls. With regard to the optimum concentration of IAA for the radicle growth, it was found to be 10^{-3} ppm and 10^{-4} ppm for *Ricinus* and soybean respectively, studies to substantiate this view are lacking. A poly-modal palæocurrent pattern in the Pocono formation of Pennsylvania was noted by Pelletier (1958) and he attributed it to the divergencies of the stream system.



FIGS. 1–5. Compass-diagrams presenting number of measurements per 30° sector. Modes shown by shaded sectors. Sectors within one standard deviation of the mean are stippled and sectors below the difference of mean and standard deviation are left blank. Fig. 1. Compass-diagram for Semri Series in Chattarpur District. Fig. 2. Compass-diagram for Kaimur Series around Gwalior. Fig. 3. Compass-diagram for Rewa Series around Jhansi-Sagar Road. Fig. 4. Compass-diagram for Rewa Series around Sagar. Fig. 5. Rose-diagram for Rewa Series around Sagar.

On the basis of the data presented in this note and an analysis of the data of Mishra (1967) on the south-western part of the basin, and of Jafar *et al.* (1966) for Fatehpur Sikri (Agra), it is evident that the provenance shifted from the north-west during Semri deposition towards an east to south-west range of directions during the Upper Vindhyan, although the data are still not sufficient to be certain. If true, the orientation and the position of the basin must also have changed.

ACKNOWLEDGEMENTS

The authors are greatly indebted to J. M. Hancock, King's College, University of London, for reading the manuscript and offering suggestions for its improvement. They also wish to extend their gratitude to R. C. Selley, Imperial College and H. C. Potter, King's College, London, for constructive suggestions.

---

1. Banerjee, I. and Sen Gupta, S., *Quart. Jour. Geol. Min. Met. Soc. India*, 1963, **35** (2).
2. Jafar, S. A., Akhtar, K. and Shrivastava, V. K., *Bull. Geol. Soc. Ind.*, 1966, **3**, 82.
3. Mishra, S. K., *Curr. Sci.*, 1967, p. 21.
4. Pelletier, B. R., *Geol. Soc. Amer. Bull.*, 1958, p. 69.
5. Selley, R. C., *Jour. Geol.*, 1967, p. 75.
6. Tanner, W. F., *Jour. Sed. Petrol.*, 1959, **29** (2).

INTERACTION BETWEEN GIBBERELLIC ACID AND INDOLE ACETIC ACID

H. A. FODA, M. E. YOUNIS AND A. S. El-GOBASHY

Department of Botany, Faculty of Science, A'in Shams University, Abbassia, Cairo, U.A.R.

INTRODUCTION

GIBBERELLINS are now considered to represent a group of plant hormones with an action clearly distinguished from that of auxins. Treatment of a variety of plants with gibberellic acid (GA) was found to increase the shoot growth and the relation was directly proportional to the dose of applied GA (*see* Audus, 1963; Singh, 1967; Devlin, 1966).

Recently, El-Gobashy (1969) found that GA treatment significantly increased stem height, number of leaves, fresh and dry weight of shoots of soybean and *Ricinus communis.* The increase in shoot length of GA-treated plants was accompanied with a decrease in stem thickness and number of branches. In the case of soybean, an inhibition of root growth was observed in GA-treated seedlings.

The same author also found that stem apices of GA-treated soybean or *Ricinus* plants had more extractable endogenous auxins than those of the untreated plants, specially at the early stages of plant development. The activity level of such auxins was found to be proportional to the concentration of the applied GA.

The following experiments were carried out to show if there is any interaction between GA and indole acetic acid (IAA), using the hypocotyls and radicles of soybean and *Ricinus communis.*

MATERIALS

The test objects used in the present work were the hypocotyls and radicles of soybean and *Ricinus communis.* The seeds of the two plants were kindly provided by the Ministry of Agriculture of U.A.R.

Seeds of *Ricinus* and soybean were germinated on moistened cotton wool in large petri dishes in a dark room at about 30° C. Sections from uniform hypocotyls and radicles were excised from *Ricinus* seedlings when they were 6 days old and from soybean seedlings when they were 4 days old. The sections were excised from the upper meristematic part of the hypocotyls and from the meristematic zones of radicles next to the root tips.

EXPERIMENT I

Interation between GA at a Constant Concentration and IAA at Different Concentrations

Method.—A set of 9 solutions containing a constant concentration of GA and different dilutions of IAA (10^3, 10^2, 10^1, 10^0, 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4} and 10^{-5} ppm) was prepared. The concentration of GA used was the optimum concentration for the growth of the test plants. Thus, it has been found in a preliminary experiment that the optimum concentration of GA for the growth of *Ricinus* hypocotyl sections was 10 ppm, while it was 1 ppm in the case of soybean hypocotyl segments. With regard to the optimum concentration of GA for the root growth, it was found to be 10^{-4} ppm in the case of *Ricinus* and 10^{-5} ppm for soybean.

A control set of IAA at the same concentrations, just mentioned above, was also prepared in the absence of GA.

The activities of the different solutions of the 2 sets, in the presence and absence of GA, were assayed using hypocotyl and radicle sections of *Ricinus* and soybean seedlings. At the same time, control dishes of distilled water were also bioassayed.

The growth of hypocotyl and radicle sections, expressed as percentage of the control, was plotted against the concentration of IAA. The results are shown in Fig. 1 for *Ricinus* and in Fig. 2 for soybean.

Results.—When IAA was used alone, its relatively high concentrations inhibited the straight growth of the hypocotyl and radicle sections of the two plants under investigation. By further dilutions of IAA, the growth of the hypocotyl and radicle sections was gradually stimulated, reached a maximum value at an optimum concentration and then decreased at lower dilutions of IAA (*see* Figs. 1 and 2). The optimum concentration of IAA for the growth of *Ricinus* hypocotyls was 1 ppm while it was 10^{-1} ppm for soybean hypocotyls. With regard to the optimum concentration of IAA for the radicle growth, it was found to be 10^{-3} ppm and 10^{-4} ppm for *Ricinus* and soybean respectively.

When the optimum concentration of GA was added to the different dilutions of IAA, the growth of the hypocotyl and radicle sections of *Ricinus* and soybean was markedly increased as compared with the effect of IAA alone. The magnitude of such synergistic action of GA and IAA was more pronounced for the growth of hypocotyls than for that of radicles of the two plants (Figs. 1 and 2).

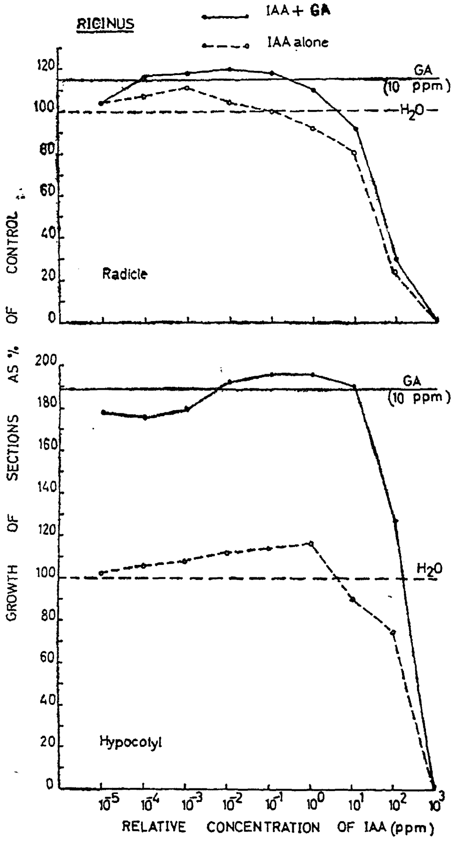


FIG. 1

EXPERIMENT II

Interaction between GA at Different Concentrations and IAA at a Constant Concentration

Method.—A set of 9 petri dishes containing a constant concentration of IAA and different dilutions of GA (10^3, 10^2, 10^1, 10^0, 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4} and 10^{-5} ppm) was prepared. The concentration of IAA used, was the optimum concentration for the growth of the plant material as found in experiment I. The optimum concentrations of IAA for the growth of hypocotyl sections was 1 ppm in the case of *Ricinus* and 10^{-1} ppm in the case of soybean. For the radicle growth of *Ricinus* and soybean the optimum concentrations of IAA were 10^{-4} ppm and 10^{-3} ppm respectively (*see* Figs. 1 and 2).

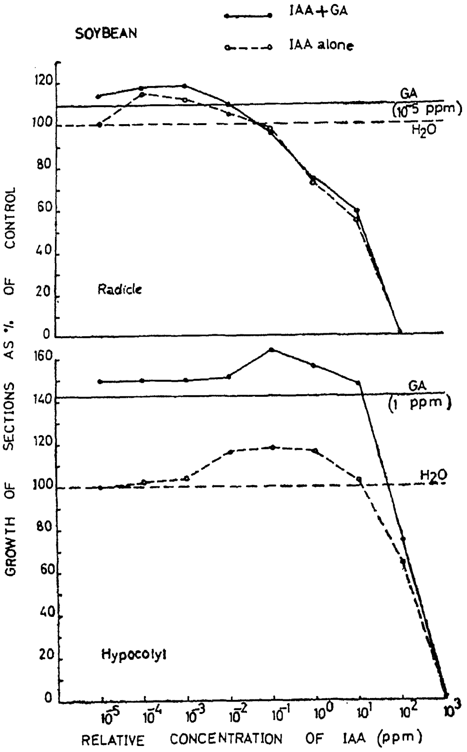


FIG. 2

Another set of 9 dishes containing the above-mentioned concentrations of GA, in the absence of IAA, was also prepared.

The activities of the different solutions of the two sets, in the presence and absence of IAA, were assayed by hypocotyl and radicle sections of the 2 plants under investigation. Control dishes of distilled water were also bioassayed. The results are expressed graphically in Fig. 3 for *Ricinus* and in Fig. 4 for soybean.

Results.—The growth of the hypocotyl and radicle sections of *Ricinus* and soybean was inhibited by the relatively high concentrations of GA (Figs. 3 and 4). At lower concentrations, GA stimulated the growth of the plant sections. The optimum concentration of GA for the growth of the hypocotyl sections was shown to be 10 ppm and 1 ppm for *Ricinus* and soybean respectively. For the radicle growth, the optimum concentrations of GA were found to be 10^{-4} ppm in the case of *Ricinus* and 10^{-5} ppm for soybean.

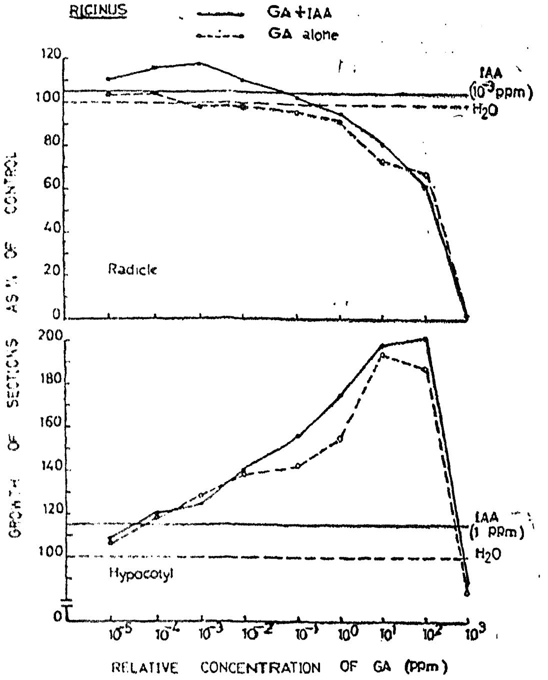


FIG. 3

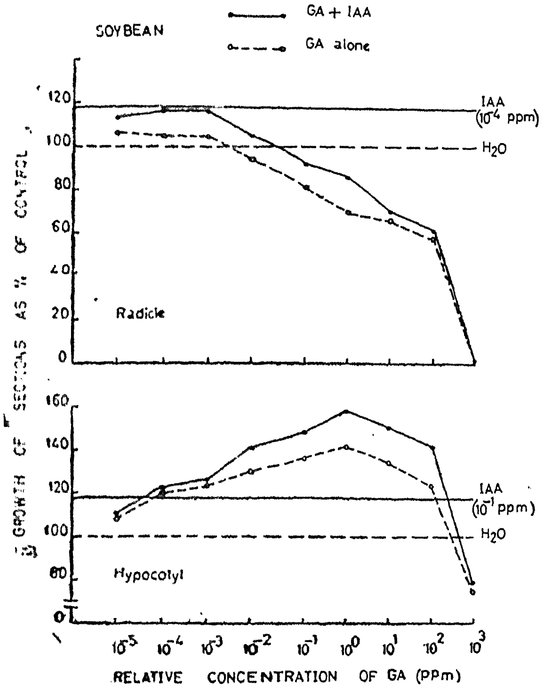


FIG. 4

When the optimum concentration of IAA was added to the different dilutions of GA, they showed a synergistic action on the growth of the hypocotyl and radicle sections of both *Ricinus* and soybean (Figs. 3 and 4).

DISCUSSION

The possibility that gibberellin acts by protecting or stimulating native or exogenous auxins has been raised by a number of workers (Paleg, 1965 ; El-Gobashy, 1969).

In the present investigation, a synergistic action is found between GA and IAA. Such synergism was more evident in case of hypocotyl growth of *Ricinus* and soybean than in case of their radicle growth. In support of this observation Brian and Hemming (1961) reported that synergism could be demonstrated not only between GA and IAA but also between GA and certain synthetic auxins.

A very tempting explanation of GA and IAA synergism is that GA directly or indirectly inhibits metabolic destruction of IAA. Another satisfactory explanation is that gibberellin may stimulate some steps in the biosynthetic pathways of auxins (Paleg, 1965). Supporting this view, Kuraishi and Muir (1964) and Muir (1964) have found that treatment of tomato ovaries or dwarf pea apices yields preparations that were able to convert tryptophan to auxin at a greater rate than preparations from untreated plants.

SUMMARY

A possible interaction between gibberellic acid (GA) and indole acetic acid (IAA) was investigated using the hypocotyls and radicles of soybean and *Ricinus communis* as test objects. There was a marked synergistic action between GA and IAA. Such synergism was much more evident in case of hypocotyl growth than in case of radicle growth.

---

1. Audus, L. J., *Plant Growth Substances*, Leonard Hill (Books) Limited, London, 1963.
2. Brian, P. W. and Hemming, H. G., *Nature*, 1961, **189**, **74**.
3. Devlin, R. M., *Plant Physiology*, Reinhold Publishing Corporation, New York, 1966.
4. El-Gobashy, A. S., "Physiological studies on gibberellic acid," *Ph.D. Thesis*, A'in Shams University, Cairo, 1969.
5. Kuraishi, S. and Muir, R. M., *Plant and Cell Physiol.*, 1964, **5**, 61 & 259.
6. Muir, R. M., *Plant Physiol.*, 1964, 39, Suppl. XVII.
7. Paleg, L. G., *Ann. Rev. Plant Physiol.*, 1965, **16**, 291.
8. Singh, A., *Plant Physiology*, Asia Publishing House, New York, 1967.

LETTERS TO THE EDITOR

ROTATIONAL ANALYSIS OF $^3\Pi_{0,1}$–$X^1\Sigma$ SYSTEM OF AlI

THE emission spectrum of aluminium monoiodide was reported by Miescher (1935 and 1936)[1,2] to consist of two discrete band systems in the regions λ 3450 – λ 3050 and λ 4750 – λ 4330. The ultraviolet system consisting of a single progression of diffuse bands was attributed to a $^1\Pi$–$X^1\Sigma$ transition. From a study of vibrational analysis, the bands in the visible region were assigned to two subsystems arising from $^3\Pi_{0,1}$–$X^1\Sigma$ transitions of the AlI molecule. However, the transitions were not so far confirmed from a detailed study of the rotational analysis.

We have recently reinvestigated the emission spectrum of AlI in the visible region in a high frequency discharge from a 1/2 K.W. oscillator. Spectra are photographed in the second order of a 21 ft. concave grating spectrograph at a dispersion of 0·625 Å/mm. The (0, 0) and (0, 1) bands of the first subsystem ($^3\Pi_0$–$X^1\Sigma$), and the (0, 0) band of the second subsystem ($^3\Pi_1$–$X^1\Sigma$), are well resolved and found suitable for a study of the rotational analysis. The rotational structure of the bands of the first subsystem revealed the expected two branches P and R, while the (0, 0) band of the second subsystem showed an intense Q branch in addition to P and R branches. The J numbering in the P and R branches is determined by a comparison of the observed $\Delta_2 F'(J)$ values for the common upper $v' = 0$ level. The rotational constants of the upper and lower states are determined from a detailed study of the rotational analysis. From a knowledge of B_0'' and D_0'' constants of the first subsystem, the rotational analysis of the (0, 0) band of the second subsystem is carried out. The rotational constants of the various levels of $^3\Pi_0$, $^3\Pi_1$ and $X^1\Sigma$ states of the AlI molecule as determined from the analysis are summarised in Table I.

TABLE I

Rotational constants of the various levels of $^3\Pi_0$, $^3\Pi_1$ and $X^1\Sigma$ states of AlI

State	B_0 in cm.$^{-1}$	B_1 in cm.$^{-1}$	D_0 $\times 10^{-7}$ cm.$^{-1}$	r_0 $\times 10^{-8}$ cm.	I_0 $\times 10^{-40}$ gm. cm.^{2}
$^3\Pi_1$ ..	$0{\cdot}123_6$	..	$0{\cdot}4_4$	2·476	226·4
$^3\Pi_0$ ..	$0{\cdot}123_5$	..	$0{\cdot}5_1$	2·477	226·6
$X^1\Sigma$ ..	$0{\cdot}118_3$	$0{\cdot}117_6$	$0{\cdot}3_9$	2·530	236·6

Spectroscopy Lab., A. LAKSHMINARAYANA.
Department of Physics, P. B. V. HARANATH.
Andhra University,
Waltair (A.P.), *January* 23, 1970.

---

1. Miescher, E., *Helv. Phys. Acta*, 1935, **8**, 279.
2. —, *Ibid.*, 1936, **9**, 693.

FLUORESCENCE SPECTRUM OF p-DIFLUOROBENZENE MOLECULE

PARA-DIFLUOROBENZENE molecule has been studied spectroscopically by a number of workers in infrared, Raman[1,2] and electronic absorption.[3,4] The solution spectrum in liquid is available from American Petroleum Institute Research Project 44. A high resolution study of some of the vapour absorption bands has recently been carried out by Thakur.[5]

The U.V. absorption bands in the vapour state are quite sharp and large in number. On the other hand, the emission bands are not reported in literature, the reason being the rapid dissociation of these organic molecules after electronic excitation. It is found that the chemical stability of p-difluorobenzene is more and hence, there seems to be less chance of its decomposition in electrical discharge; but the possibility of impurity bands may not be ruled out completely. To overcome these difficulties, photon excitation, which is more controlled, was considered suitable to record the emission bands. This sort of study yields useful information regarding the ground state and the transition probability in the electronic transition.

The (0, 0) band of the molecule lies at 2713·4 Å and is of maximum intensity as reported from absorption study. This band was excited by the radiation of 2712·4 Å atomic line of Fe generated in spark between iron electrodes. Besides this, the other fundamental vibrations in the excited state are also excited by corresponding atomic lines of iron spark (shown in Table I). The experimental set-up

TABLE I

Wavelengths of exciting lines (in Å)	Wavelength of strong absorption band (in Å)
2712·4	2713·4
2707·5	2708·2
2686·4	2686·4
2654·3	2654·4
2598·4	2598·2

TABLE II

Comparison of observed fundamental vibrations

Raman cm.$^{-1}$		U.V. absorption cm.$^{-1}$		Fluorescence cm.$^{-1}$		Symmetry of vibrat
240		257	(4)	252	(vs)	b_{2g}
451	(m)	452	(9)	454	(vs)	a_g (C—C—C) i.p bending
840	(vs)	840	(4)	840	(ms)	a_g (C—H) i.p. bending
859	(vs)	865	(10)	865	(vs)	a_g (C—C) breathing
1245	(vs)	1261	(7)	1261	(vw)	a_g (C—F) stretching
3080	(vs)	..	..	3074	(m)	a_g (C—H) stretching

N.B.—i.p. = in plane ; m = medium ; vs = very strong ; vw = very weak.

was basically the same as reported by Bass and Sponer[6] but with certain modifications. The observation window was set perpendicular to the exciting radiation with maximum precautions to avoid extra light. Under this arrangement, the fluorescence cell was kept at room temperature and the resulting emission was photographed on a Medium Quartz Spectrograph with slit width of 50 μ on a Kodak II 0 plate. Since fluorescence yield was poor, it took about 60 hours to record the bands. This restricted us to use larger dispersion in this experiment.

The spectrum shows sharp and red degraded bands, free from any impurity spectrum. About 70 bands were measured against Cu lines as standard and were analysed in terms of six ground state and two excited state frequencies. The salient features of analysis are given here.

Thakur[5] has shown that the $D_{2h} = V_h$ symmetry of the molecule is unchanged in the excited state. The electronic transition is $^1B_{3u}-{}^1A_{1g}$ in the present case and is allowed. It is found that the totally symmetric vibrations 865 cm.$^{-1}$ is quite strong and is suggested to be ring breathing. The C-F stretching mode is the next strong vibration. On the other hand, C-H and C-F non-planar modes are weak. A similar situation is observed for C-C out of plane vibration. All the fundamentals with their respective Raman lines are collectively given in Table II.

It has been observed that the fluorescence yield is large in para-compound, whereas similar experiment has failed to give positive result in ortho- and meta-compounds. A large transition moment in para-compound has been explained by Sklar.[7]

The authors thank Prof. N. L. Singh and Dr. D. K. Rai for their kind interest in the work. One of them (J. V. S.) is also grateful to the CSIR (New Delhi) for financial help.

Dept. of Spectroscopy, (MISS) JAYA V. SHUKLA.
Faculty of Science, M. M. RAI.
Banaras Hindu Univ., K. N. UPADHYA.
Varanasi-5, India, *January* 6, 1970.

---

1. Delsemme, A. H., *J. Chem. Phys.*, 1950, **18**, 1650.
2. Ferguson, Hudson, Nielson, J. R. and Smith, *Ibid.*, 1953, **21**, 1457.
3. Delsemme, A. H. and Ducherne, *J. Compt. Rend.*, 1952, **234**, 612.
4. Cooper, C. D., *J. Chem. Phys.*, 1954, **22**, 503.
5. Thakur, S. N., *Ph.D. Thesis*, B.H.U., 1969.
6. Bass, A. M. and Sponer, H., *J. Opt. Soc. America*, 1950, **40**, 389.
7. Sklar, A. L., *J. Chem. Phys.*, 1942, **10**, 135.

FRANCK-CONDON FACTORS AND r-CENTROIDS FOR THE b-X SYSTEM OF SO MOLECULE

FRANCK-CONDON factors for the different bands arising from the B $^3\Sigma^-$–X $^3\Sigma^-$ transition of SO have been reported earlier.[1] In the present note Franck-Condon factors and r-centroids are reported for the b $^1\Sigma^+$–X $^3\Sigma^-$ band system of the SO molecule.

The approximate analytical method proposed by Fraser and Jarmain[2] has been applied for the computation of the Franck-Condon factors. Since for this system $\left|\frac{\delta a}{a}\right| \approx 6\%$, the r_e-shift correction[3] has been applied to improve the results. The r-centroids have been calculated by quadratic equation as well as graphical methods suggested by Nicholls and Jarmain.[4] The results are given in Table I. The basic molecular constants have been taken from the work of Colin.[5] The Franck-Condon factors calculated are in good agreement with the visual intensities of the bands observed. The r-centroids are found to increase with increase in corresponding wavelength as $r_{e1} > r_{e2}$.

The authors are thankful to Prof. D. Sharma and Dr. R. C. Maheshwari for their keen interest in the work.

TABLE I

v' \ v''		0	1	2	3
0	(*a*)	0·940	0·059	0·002	0·000
	(*b*)	0·937	0·062	0·002	0·000
	(*c*)	1·497	1·645	1·810	1·975
	(*d*)	1·496	1·632	1·742	1·834
	(*e*)	9549·08	10708·00	..	..
1	(*a*)	0·058	0·825	0·112	0·005
	(*b*)	0·062	0·815	..	..
	(*c*)	..	1·508	1·654	1·805
	(*d*)	..	1·510	1·630	1·746
	(*e*)	..	9625·13	..	..
2	(*a*)	0·002	0·111	0·715	0·162
	(*b*)	0·003	0·111	0·700	..
	(*c*)	..	1·320	1·519	1·659
	(*d*)	..	1·358	1·522	1·648
	(*e*)	..	..	9707·40	..
3	(*a*)	0·000	0·006	0·158	0·307
	(*b*)	0·000	..	..	0·287
	(*c*)	..	..	1 358	1·529
	(*d*)	..	..	1·372	1·532

(*a*) F.C.—factors without r_e shift, (*b*) F.C. factors with r_e shift, (*c*) r-centroids by quadratic method (*d*) r-centroids by graphical method, (*e*) wavelength (Å).

Department of Physics,
University of Gorakhpur,
Gorakhpur, U.P., *January* 27, 1970.

M. M. SHUKLA.
I. D. SINGH.

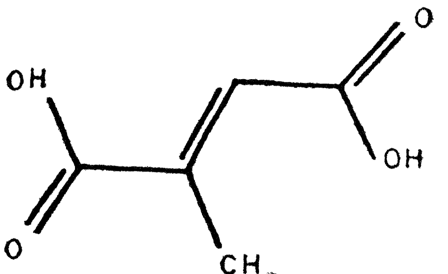
---

1. Smith, I. W. M., *J. Quant. Spectrosc. Radiative Transfer (GB)*, 1968, **8**, 1437.
2. Fraser, P. A. and Jarmain, W. R., *Proc. Phys. Soc.*, 1953, **66 A**, 1145.
3. Jarmain, W. R. and Fraser, P. A., *Ibid.*, 1953, **66 A**, 1153.
4. Nicholls, R. W. and Jarmain, W. R., *Ibid.*, 1956, **69 A**, 253.
5. Colin, R., *Canad. J. Phys.*, 1968, **46**, 1539.

THE CRYSTAL STRUCTURE OF MESACONIC ACID, $C_5H_6O_4$

As part of a programme for studying the crystal structures of simple molecules which form hydrogen bonds, we have now established the crystal and molecular structure of mesaconic acid, $C_5H_6O_4$, with stereochemical formula (*See* sketch) using X-ray diffraction data.

X-Ray Crystallographic Data.—The crystals obtained from a solution in alcohol are platy in habit with frequent twinning with the (010) face as the pronounced platy face. They are monoclinic with $a = 7 \cdot 43$ Å, $b = 11 \cdot 79$ Å, $c = 7 \cdot 00$ Å, $\beta = 109°$. The number of molecules in the unit cell $Z = 4$ with $\rho_{\text{calc}} = 1 \cdot 486$ gm./ml. The space group is uniquely established as $P2_1/c$ from the systematic absence of reflections observed: *h0l* absent when $l \neq 2n$ and *0k0* absent when $k \neq 2n$. Complete zonal and three dimensional data have been collected using Weissenberg photography (normal and equi-inclination).



The Crystal Structure. Patterson projections combined with trial and error methods have unravelled the structure, the view of the structure looking down the [001] axis being shown in Fig. 1. In the crystal, the molecules are aligned parallel to the [100] axis and form extensive chains by the process of dimerization along the chain direction with hydrogen bonds of 2·58 Å and 2·63 Å. Apart from these short hydrogen bonds, other distances of contact are van der-Waals distances (3 Å and above).

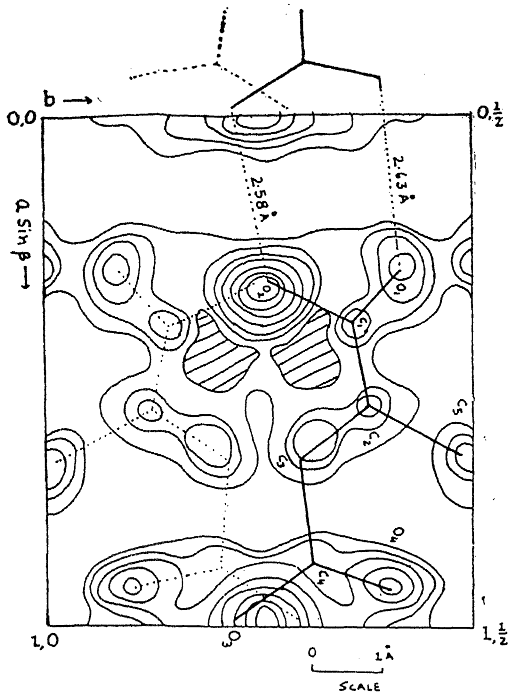


FIG. 1. The *hk0* Fourier projection of mesaconic acid.

Department of Physics,
University of Ranchi,
Ranchi-8, *January* 15, 1970.

M. P. Gupta.
S. M. Prasad.
B. N. Sahu.

A CONVENIENT METHOD FOR THE SYNTHESIS OF DI-α-NAPHTHYLOXYMETHANE

In connection with the synthesis of 11-oxa-desoxyequilenin, we wanted α-naphthyloxymethyl bromide (I) as the starting material. H. J. Barber and his co-workers[1] have reported the synthesis of α-naphthyloxymethyl chloride in 62% yield from a reaction between PCl_5 and the sodium salt of α-naphthyloxymethanesulphonic acid, the preparation of which involves the difficultly available sodium chloromethanesulphonate. With a view to evolving out a much simpler route for the preparation of the desired bromide (I), the dry sodium-α-naphthoate was treated with methylene bromide in refluxing acetone. This reaction, however, yielded instead of the expected bromide (I), a colourless crystalline solid, m.p. 88°, in 60% yield. This solid was characterised as the hitherto unknown *di-α*-naphthyloxymethane (II) based on the following evidence:

Compound (II) was isolated from the neutral ethereal layer. The ultraviolet absorption spectrum showed absorption maxima corresponding to α-naphthyl methyl ether moiety.[2] The IR spectrum in CCl_4 showed no absorption due to phenolic OH but indicated the bands at 1506, 1572, 1380 cm.$^{-1}$ characteristic of the naphthalenic double bonds[3] and also at 1258 and 1072 cm.$^{-1}$ characteristic of aralkyl ether linkage. The NMR spectrum (in $CDCl_3$) indicated a singlet of 2 proton intensity at 4·07 τ (characteristic of $-O-CH_2-O-$ protons) and a complex multiplet of 14 proton intensity between 1·87–2·75 τ (a pattern characteristic of naphthalenic nucleus).[4]

The correct elemental composition obtained for this compound (II) coupled with the aforesaid spectral data were in agreement with the assigned structure, *viz.*, *di-α*-naphthyloxymethane for this compound (II).

All attempts to convert the symmetrical ether (II) into the desired bromide (I) by treatment with calculated quantity of HBr in glacial acetic acid or with $HBr-BF_3$ etherate have failed.

Experimental.—(Melting point reported herein is uncorrected. The ultraviolet spectrum was determined in cyclohexane using Beckmann-DK2-UV-Spectrograph and the IR Spectrum was recorded using Beckmann IR-8. The NMR Spectrum was determined using Varian A 60 Å using TMS as the internal standard.)

Preparation of di-*α-naphthyloxymethane* (*II*).—To the dry sodium salt prepared from 2 g. of α-naphthol, were added 30 ml. of pure dry acetone (distilled from potassium permanganate) and 1·25 g. of methylene bromide. The mixture was refluxed under anhydrous conditions for 8 hours. After evaporation of acetone, the resulting residue was treated with water and extracted with ether (3 × 25 ml.). The ethereal extract was washed thoroughly with 10% KOH solution (3 × 30 ml.) followed by water (2 × 20 ml.). The dried ethereal extract on evaporation afforded a gummy mass which, on trituration with hexane, solidified. Two crystallizations from hexane-acetone furnished the analytical sample of (II) as a colorless crystalline solid, m.p. 88°, in 60% yield (2 g.).

Ultraviolet Spectrum.—$\lambda_{\text{max.}}^{\text{Cyclohexane}}$ 218 mμ (ε 2,386); 280 mμ (ε 1,193); 289 mμ (ε 1,295); 319 mμ (ε 1,859) characteristic of α-naphthyl methyl ether moiety.[2]

Infrared Spectrum.—(in CCl_4) showed bands at 1506 cm.$^{-1}$; 1572 cm.$^{-1}$ and 1380 cm.$^{-1}$ (aromatic C=C); 1258 cm.$^{-1}$ and 1072 cm.$^{-1}$ (C–O–C–stretch of aralkyl ether).

TABLE I

v'' / v'	0	1	2	3
0	(*a*) 0·940	(*a*) 0·059	(*a*) 0·002	(*a*) 0·000
	(*b*) 0·937	(*b*) 0·062	(*b*) 0·002	(*b*) 0·000
	(*c*) 1·497	(*c*) 1·645	(*c*) 1·810	(*c*) 1·975
	(*d*) 1·496	(*d*) 1·632	(*d*) 1·742	(*d*) 1·834
	(*e*) 9549·08	(*e*) 10708·00	(*e*) ..	(*e*) ..
1	(*a*) 0·058	(*a*) 0·825	(*a*) 0·112	(*a*) 0·005
	(*b*) 0·062	(*b*) 0·815	(*b*) ..	(*b*) ..
	(*c*) ..	(*c*) 1·508	(*c*) 1·654	(*c*) 1·805
	(*d*) ..	(*d*) 1·510	(*d*) 1·630	(*d*) 1·746
	(*e*) ..	(*e*) 9625·13	(*e*) ..	(*e*) ..
2	(*a*) 0·002	(*a*) 0·111	(*a*) 0·715	(*a*) 0·162
	(*b*) 0·003	(*b*) 0·111	(*b*) 0·700	(*b*) ..
	(*e*) ..	(*c*) 1·320	(*c*) 1·519	(*c*) 1·659
	(*d*) ..	(*d*) 1·358	(*d*) 1·522	(*d*) 1·648
	(*e*) ..	(*e*) ..	(*e*) 9707·40	(*e*) ..
3	(*a*) 0·000	(*a*) 0·006	(*a*) 0·158	(*a*) 0·307
	(*b*) 0·000	(*b*) ..	(*b*) ..	(*b*) 0·287
	(*c*) ..	(*c*) ..	(*c*) 1 358	(*c*) 1·529
	(*d*) ..	(*d*) ..	(*d*) 1·372	(*d*) 1·532

(*a*) F.C.—factors without r_e shift, (*b*) F–C factors with r_e shift, (*c*) r–centroids by quadratic method, (*d*) r–centroids by graphical method, (*e*) wavelength (Å).

Department of Physics, University of Gorakhpur, Gorakhpur, U.P., *January* 27, 1970.

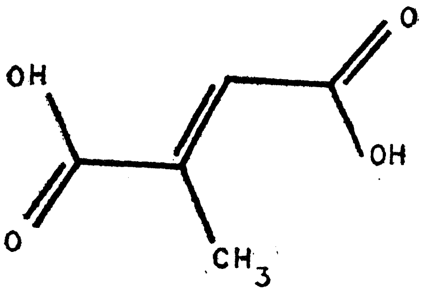
M. M. SHUKLA.
I. D. SINGH.

1. Smith, 1. W. M., *J. Quant. Spectrosc. Radiative Transfer (GB)*, 1968, **8**, 1437.
2. Fraser, P. A. and Jarmain, W. R., *Proc. Phys. Soc.*, 1953, **66 A**, 1145.
3. Jarmain, W. R. and Fraser, P. A., *Ibid.*, 1953, **66 A**, 1153.
4. Nicholls, R. W. and Jarmain, W. R., *Ibid.*, 1956, **69 A**, 253.
5. Colin, R., *Canad. J. Phys.*, 1968, **46**, 1539.

THE CRYSTAL STRUCTURE OF MESACONIC ACID, $C_5H_6O_4$

As part of a programme for studying the crystal structures of simple molecules which form hydrogen bonds, we have now established the crystal and molecular structure of mesaconic acid, $C_5H_6O_4$, with stereochemical formula (*See* sketch) using X-ray diffraction data.

X-Ray Crystallographic Data.—The crystals obtained from a solution in alcohol are platy in habit with frequent twinning with the (010) face as the pronounced platy face. They are monoclinic with $a = 7 \cdot 43$ Å, $b = 11 \cdot 79$ Å, $c = 7 \cdot 00$ Å, $\beta = 109°$. The number of molecules in the unit cell $Z = 4$ with $\rho_{\text{calc}} = 1 \cdot 486$ gm./ml. The space group is uniquely established as $P2_1/c$ from the systematic absence of reflections observed: *hol* absent when $1 \neq 2n$ and *oko* absent when $k \neq 2n$. Complete zonal and three-dimensional data have been collected using Weissenberg photography (normal and equi-inclination).



The Crystal Structure.—Patterson projections combined with trial and error methods have unravelled the structure, the view of the structure looking down the [001] axis being shown in Fig. 1. In the crystal, the molecules are aligned parallel to the [100] axis and form extensive chains by the process of dimerization along the chain direction with hydrogen bonds of 2·58 Å and 2·63 Å. Apart from these short hydrogen bonds, other distances of contact are van der-Waals distances (3 Å and above).

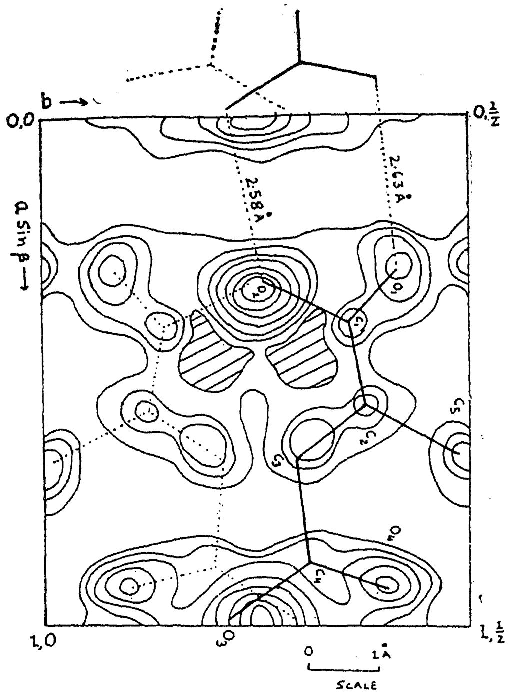


FIG. 1. The *hko* Fourier projection of mesacoric acid.

Department of Physics, M. P. GUPTA.
University of Ranchi, S. M. PRASAD.
Ranchi-8, *January* 15, 1970. B. N. SAHU.

A CONVENIENT METHOD FOR THE SYNTHESIS OF DI-α-NAPHTHYLOXYMETHANE

IN connection with the synthesis of 11-oxa-desoxyequilenin, we wanted α-naphthyloxy-methyl bromide (I) as the starting material. H. J. Barber and his co-workers[1] have reported the synthesis of α-naphthyloxymethyl chloride in 62% yield from a reaction between PCl_5 and the sodium salt of α-naphthyloxymethanesulphonic acid, the preparation of which involves the difficultly available sodium chloromethanesulphonate. With a view to evolving out a much simpler route for the preparation of the desired bromide (I), the dry sodium-α-naphthoate was treated with methylene bromide in refluxing acetone. This reaction, however, yielded instead of the expected bromide (I), a colourless crystalline solid, m.p. 88°, in 60% yield. This solid was characterised as the hitherto unknown *di-α-*naphthyloxymethane (II) based on the following evidence:

Compound (II) was isolated from the neutral ethereal layer. The ultraviolet absorption spectrum showed absorption maxima corresponding to α-naphthyl methyl ether moiety.[2] The IR spectrum in CCl_4 showed no absorption due to phenolic OH but indicated the bands at 1506, 1572, 1380 cm.$^{-1}$ characteristic of the naphthalenic double bonds[3] and also at 1258 and 1072 cm.$^{-1}$ characteristic of aralkyl ether linkage. The NMR spectrum (in $CDCl_3$) indicated a singlet of 2 proton intensity at 4·07 τ (characteristic of $-O-CH_2-O-$ protons) and a complex multiplet of 14 proton intensity between 1·87–2·75 τ (a pattern characteristic of naphthalenic nucleus).[4]

The correct elemental composition obtained for this compound (II) coupled with the aforesaid spectral data were in agreement with the assigned structure, *viz.*, *di-α-*naphthyloxymethane for this compound (II).

All attempts to convert the symmetrical ether (II) into the desired bromide (I) by treatment with calculated quantity of HBr in glacial acetic acid or with $HBr-BF_3$ etherate have failed.

Experimental.—(Melting point reported herein is uncorrected. The ultraviolet spectrum was determined in cyclohexane using Beckmann-DK2-UV-Spectrograph and the IR Spectrum was recorded using Beckmann IR-8. The NMR Spectrum was determined using Varian A 60 Å using TMS as the internal standard.)

Preparation of di-*α-naphthyloxymethane* (*II*).—To the dry sodium salt prepared from 2 g. of α-naphthol, were added 30 ml. of pure dry acetone (distilled from potassium permanganate) and 1·25 g. of methylene bromide. The mixture was refluxed under anhydrous conditions for 8 hours. After evaporation of acetone, the resulting residue was treated with water and extracted with ether (3 × 25 ml.). The ethereal extract was washed thoroughly with 10% KOH solution (3 × 30 ml.) followed by water (2 × 20 ml.). The dried ethereal extract on evaporation afforded a gummy mass which, on trituration with hexane, solidified. Two crystallizations from hexane-acetone furnished the analytical sample of (II) as a colorless crystalline solid, m.p. 88°, in 60% yield (2 g.).

Ultraviolet Spectrum.—$\lambda_{\text{max.}}^{\text{Cyclohexane}}$ 218 mμ (ϵ 2,386); 280 mμ (ϵ 1,193); 289 mμ (ϵ 1,295); 319 mμ (ϵ 1,859) characteristic of α-naphthyl methyl ether moiety.[2]

Infrared Spectrum.—(in CCl_4) showed bands at 1506 cm.$^{-1}$; 1572 cm.$^{-1}$ and 1380 cm.$^{-1}$ (aromatic C=C); 1258 cm.$^{-1}$ and 1072 cm.$^{-1}$ (C–O–C-stretch of aralkyl ether).

NMR(in $CDCl_3$): a singlet of 2H intensity at 4·05 τ(–O–CH_2–O–); a multiplet of 14H intensity at 1·87 to 2·75 τ(characteristic of naphthalene moiety).

Analysis—Found: C, 83·87%; H, 5·6%. $C_{21}H_{16}O_2$ requires C, 84·01%; H, 5·33%.

We wish to thank Prof. (Dr.) G. Schröder, Professor of Organic Chemistry, Institut für Organische Chemie der Universität, Karlsruhe, for getting the above-mentioned spectral and micro-analytical data. One of us (J. R.) is indebted to the authorities of the Institute for the award of a Fellowship.

Department of Chemistry, S. R. RAMADAS.
Indian Institute of Tech., J. RADHAKRISHNAN.
Madras-36, *January* 31, 1970.

---

1. Barber, H. J., Fuller, R. F., Green, M. B. and Zwartouw, H. T., *J. Appl. Chem.*, 1953, **3**, 266.
2. Wingfield, H. C. and Yoe, J. H., *Anal. Chim. Acta*, 1956, **14**, 446.
3. Rao, *Chemical Applications of Infrared Spectroscopy*, Academic Press, New York, 1963, p. 164.
4. Jonathan, N., Gordon, S. and Dailey, B. P., *J. Chem. Phys.*, 1962, **36**, 2443.

SOLUBILITY LIMIT OF $La_{0\cdot5}Li_{0\cdot5}TiO_3$ IN $BaTiO_3$

PEROVSKITE-like compounds of the type ABO_3 can be obtained with A and B ions which have ionic radii within fairly wide limits.[1] The same structure type can be found in solid solutions of the type $A(B_iB_j)O_3$[2] and $(A_iA_j)BO_3$[3] and even in the quaternary systems of the general type $(A_iA_j)(B_iB_j)O_3$.[4] Accordingly, one can consider the preparation of perovskite-type compounds with more complicated combinations of atoms than these provided, of course, that the charge neutrality is preserved.

The preparation and structural characteristics of $La_{0\cdot5}Li_{0\cdot5}TiO_3$ and its solid solutions with $BaTiO_3$ are reported here. $BaTiO_3$ and $La_{0\cdot5}Li_{0\cdot5}TiO_3$ were prepared by the solid state reaction between the respective oxides at 1300° C. Pure $La_{0\cdot5}Li_{0\cdot5}TiO_3$ crystallises in the cubic perovskite lattice with $a = 3\cdot87$ Å, and having La^{3+} and Li^+ ions distributed statistically over the Ca^{2+} sites in $CaTiO_3$. The unit cell dimensions of the mixed phases between $BaTiO_3$ and $La_{0\cdot5}Li_{0\cdot5}TiO_3$ were determined at various compositions by the X-ray powder diffraction technique.

A homogeneous phase is formed till 50 mole % incorporation of $La_{0\cdot5}Li_{0\cdot5}TiO_3$ in $BaTiO_3$. The lattice constant decreases progressively from 4·01 Å for pure $BaTiO_3$ to 3·97 Å for 1 : 1 $BaTiO_3$–$La_{0\cdot5}Li_{0\cdot5}TiO_3$. It was, however, observed that the tetragonal distortion responsible for ferroelectricity in $BaTiO_3$ is destroyed by the addition of more than 2 mole % $La_{0\cdot5}Li_{0\cdot5}TiO_3$. As the concentration of $La_{0\cdot5}Li_{0\cdot5}TiO_3$ increases, the two phases separate out and no homogeneous phase is formed in the samples 50–92 mole % $La_{0\cdot5}Li_{0\cdot5}TiO_3$ heated to 1400° C.

In the range 92 mole % –100 mole % $La_{0\cdot5}Li_{0\cdot5}TiO_3$ a homogeneous cubic perovskite phase is formed. The change in the lattice constant in this region if any is less than ± 0·01 Å.

The authors wish to thank Prof. Dr. A. B. Biswas, of IIT, Bombay-76 for his fruitful and critical suggestions.

Dept. of Physical and P. V. PATIL.
Solid State Chemistry, V. S. CHINCHOLKAR.
Institute of Science,
Nagpur, *February* 12, 1970.

---

1. Jona, F. and Shirane, G., *Ferroelectric Crystals*, Pergamon Press, 1962, p. 219.
2. Jaffe, B., Roth, R. S. and Marzullo, S., *J. Res. Natl. Bur. Stand.*, 1955, **55**, 239.
3. Shirane, G. and Suzuki, K., *J. Phys. Soc. Japan*, 1951, **6**, 274.
4. Chincholkar, V. S., Sanjana, N. R. and Biswas, A. B., *Ind. J. Pure Appl. Phys.*, 1969, **7** (11), 724.

REACTION OF POLYTHIONATES WITH IODINE MONOCHLORIDE

POLYTHIONATES occupy a position of special importance among the oxysalts of sulphur and their reactions have been widely studied. In this communication, we report on a novel reaction of tri- and tetrathionates, *viz.*, their oxidation with iodine monochloride. It is found that this oxidant oxidises all the sulphur in these polythionates to the + 6 oxidation state.

Reagents.—Potassium trithionate and potassium tetrathionate were prepared by the methods of Stamm and Goehring[1] employing the reaction between aqueous sulphite and pertroleum ether solutions of sulphur dichloride and disulphur dichloride respectively. Their purities were checked by the sulphite, cyanide and sulphide degradation methods of Kurtenacker[2] and by the chloramine-T method of Vasudeva Murthy.[3] The samples were found to be 99·5% pure.

Stock decimolar iodine monochloride solutions in 5 M HCl were prepared by standard methods.[4] These were washed with carbon tetrachloride to remove any traces of admixed

TABLE I

Oxidation of polythionates with iodine monochloride

	Substance	Millimoles polythionate taken	Milliequivalents iodine produced	Millimoles iodine monochloride reacted	No. of equivalents of iodine produced per mole of polythionate	No. of moles of iodine monochloride reacting per mole of polythionate
1.	Potassium trithionate ..	0·07044	0·5665	0·5665	8·042	8·042
2.	,, ..	0·09391	0·7504	0·7484	7·991	7·896
3.	,, ..	0·1174	0·9441	0·9419	8·041	8·023
4.	,, ..	0·1409	1·123	1·128	7·971	8·009
5.	Potassium tetra thionate	0·07506	1·051	1·055	14·01	14·07
6.	,, ..	0·07506	1·055	1·055	14·07	14·07
7.	,, ..	0·1126	1·575	1·581	13·99	14·04
8.	,, ..	0·1501	2·101	2·112	14·00	14·07

iodine before standardisation and use. The standardisation was carried out iodometrically, by pipetting measured aliquots into 10 ml. 10% KI solution, diluting well and titrating the liberated iodine with standard thiosulphate.

Procedure.—The oxidation reactions were studied as follows. To measured aliquots of the standard iodine monochloride solution taken in stoppered separating funnels, known volumes of the standard polythionate solution were added. Reaction was instantaneous, as shown by the visible liberation of iodine, which fell down as lustrous black crystals in this medium, which now was iodide-free.

In order to study the stoichiometry of the reaction fully, it was considered desirable to separate this precipitated iodine from the system. This was done by quantitatively extracting it with pure CCl_4 (by successive extraction). The CCl_4 extracts were combined and the iodine was determined by leaching it with aqueous KI and titrating with standard thiosulphate. The unconsumed iodine monochloride in the aqueous layer was determined iodometrically. It may be mentioned here that in the 5 M HCl medium employed, iodine monochloride exists mostly as a complex anion, presumably ICl_2^-, and is practically insoluble in CCl_4 under these conditions.[5] This enables a successful quantitative separation from iodine by the CCl_4 extraction procedure.

Results and Discussion.—Typical results are given in Table I. It is found that one mole of trithionate reacts with 8 moles of iodine monochloride liberating 8 equivalents of iodine, whereas one mole of tetrathionate reacts with 14 moles of iodine monochloride producing 14 equivalents of iodine. This agrees with the following equations:

Trithionate:

$$S_3O_6^{=} + 6H_2O \rightarrow 3SO_4^{=} + 12H^+ + 8e^-$$
$$8ICl + 8e^- \rightarrow 8I + 8Cl^-.$$

Tetrathionate:

$$S_4O_6^{=} + 10H_2O \rightarrow 4SO_4^{=} + 2OH^+ + 14e^-$$
$$14ICl + 14e^- \rightarrow 14I + 14Cl^-.$$

We thank the University Grants Commission for the award of a Junior Research Scholarship to one of us (P. N. K. N.).

University Dept. of Chemistry,
Kerala University,
Trivandrum-1, *January* 8, 1970.
P. N. KRISHNAN NAMBISAN.
C. G. RAMACHANDRAN NAIR.

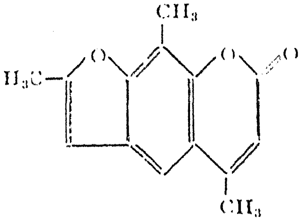
---

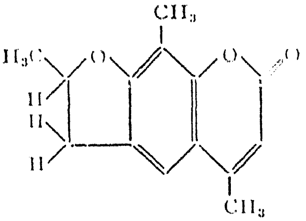
1. Stamm, H. and Goehring, M., *Z. anorg. allg. Chem.*, 1942, **250**, 226.
2. Kurtenacker, A. and Goldbach, E., *Ibid.*, 1927, **166**, 177.
3. Sharada, K. and Vasudeva Murthy, A. R., *Z. anal. Chem.*, 1960, **177**, 26.
4. Meites, L., *Handbook of Analytical Chemistry*, McGraw-Hill, New York, 1963, Section 12, p. 173.
5. Philbrick, F. A., *J. Am. Chem. Soc.*, 1934, **56**, 1257.

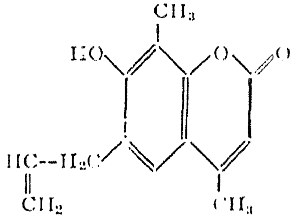
A MODIFIED SYNTHESIS OF 4, 5′, 8-TRIMETHYLPSORALENE

4, 5′ 8-Trimethylpsoralene (I) has been isolated from the diseased cultivated celery by Scheel and co-workers.[1] It has been also reported by Pathak *et al.*[2] that properly located alkyl groups do not decrease the photodynamic activity of psoralene appreciably and particularly that 4, 5′, 8-trimethylpsoralene is as active as psoralene in producing erythermal response on guinea-pig's skin irradiated with ultra-violet light.

Kaufman[3] synthesised 4, 5′, 8-trimethylpsoralene by first carrying out the Claisen rearrangement of 7-allyloxy-4, 8-dimethylcoumarin to 7-hydroxy-6-allyl-4, 8-dimethylcoumarin (II). This, on acetylation, bromination followed by ring closure with sodium ethoxide afforded (I). In view of the above pharmacological properties of (I), we report here its synthesis from (II) in better yields by using the modified technique developed by Shaikh and Trivedi.[4] 7-Hydroxy-6-allyl-4, 8-dimethylcoumarin was triturated with concentrated sulphuric acid for 10 minutes at room temperature to give 4, 5′, 8-trimethyl-4′, 5′-dihydropsoralene (III), m.p. 176° (Found: C, 72·96%; H, 5·91%. $C_{14}H_{14}O_3$ requires C, 73·02%; H, 6·13%).


(I)


(III)


(II)

Compound (III) was dehydrogenated by refluxing it in diphenyl ether in the presence of palladised charcoal (10%) to give (I), m.p. 232° identical with the compound prepared according to Kaufman.[3]

Thanks are due to Professor S. Sethna for his keen interest in this work and to Dr. S. S. Lele for microanalysis of the sample.

Chemistry Department, M. G. Parekh.
Faculty of Science, K. N. Trivedi.
M.S. University of Baroda,
Baroda-2, *February* 25, 1970.

---

1. Scheel, L. D. *et al.*, *Biochemistry*, 1960, **35**, 165.
2. Pathak, M. A. *et al.*, *J. Invest. Dermatol.*, 1960, **35**, 165.
3. Kaufman, K. D., *J. Org. Chem.*, 1961, **26**, 117.
4. Shaikh, Y. A. and Trivedi, K. N., *Curr. Sci.*, 1969, **38**, 409

RADIOIODINE INDUCED THYROID TUMOURS IN THE INDIAN FRESHWATER CAT-FISH *MYSTUS VITTATUS* (BLOCH.)

The thyroid gland of *M. vittatus* is in the form of scattered follicles situated around the ventral aorta and its afferent branchial arteries (Fig. 1). As such surgical extirpation of the gland is not possible. In teleosts in general, with few exceptions where the thyroid is compact, hypothyroidism is produced either by radioiodine or by chemical inhibitors. These inhibitors are frequently referred to as goitrogens[6-10] and they are known to be toxic and producing peripheral ill-effects. Radiothyroidectomy has been attempted in several species of fishes using relatively large doses of I-131.[1-3, 8-11] It is believed that radiothyroidectomy is not accompanied by detectable secondary radiation damage.[7] Although I-131-induced tumours are rare of occurrence in fishes, in mammals radioiodine has been implicated in the development of benign and malignant thyroid neoplasm.[5] In this study radioiodine-induced tumours showing carcinogenic tendencies in the thyroid of *M. vittatus* are described.

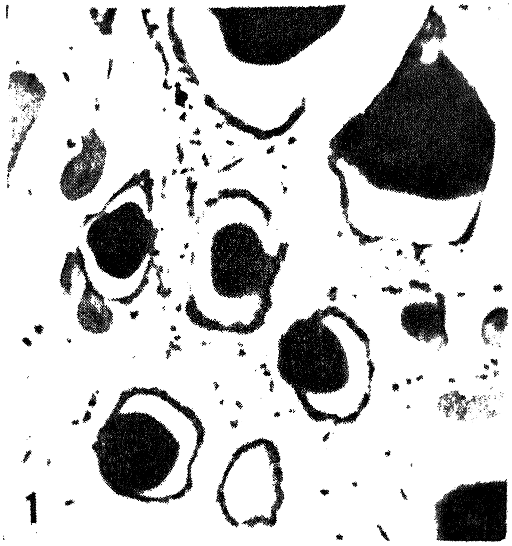


FIG. 1. Cystic thyroid after one mCi I-131 treatment, × 450.

Ten adult *M. vittatus* having an average length of 10 cm. and weight of 10·5 gm. were used. Six of them were given one millicurie (mCi) I-131 in single intra-peritoneal injection or in instalments of 750, 250, and 250

microcurie (μci) at intervals of 3 and 4 months. Four specimens received 750 μci in a solitary injection. They were sacrificed at intervals of one to eight months. The pharyngeal region with the thyroid follicles was fixed in Bouin's fluid, and paraffin sections were cut at 5 and 7 micra thick and stained in PAS-Hæmatoxylin. A fish which received one mCi in instalments exhibited several cystic tumours in the thyroid at the end of the eighth month. In the remaining treated fish, although an extensive replacement of epithelial cells with connective tissue was noticed from the second month onwards, no typical cysts were present. The tumours had a diameter range of 10 to 80 μ. Among them few scattered microfollicles with colloid also were seen (Fig. 2). These follicles were capable of trapping radioiodine. They have very low uptake value and their radioautograph is represented by few faint spots. This obviously showed that a major portion of the gland has been completely destroyed.

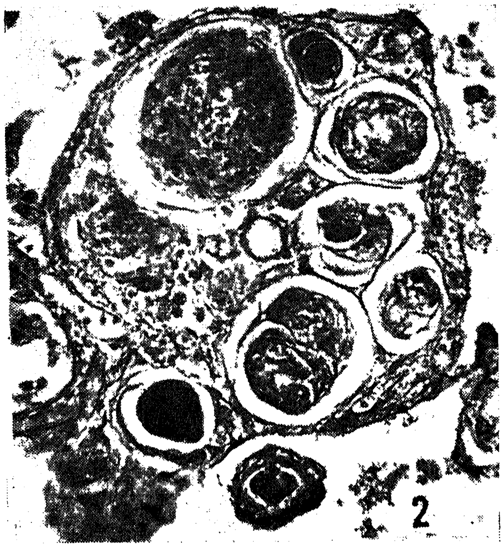


FIG. 2. Normal thyroid. Bouin's fluid : PAS-Hæmatoxylin, × 450.

Although several of the cystic tumours were encapsulated, those without limiting capsules were also not uncommon. Their histological picture also exhibited variations. Some encapsulated tumours were fibrocellular with varying amounts of stainable debris whereas some others were in the form of solid cellular masses (Fig. 2). Oclasionally, few of them lost their capsulated nature due to active proliferation of its component cells. These proliferating cells infiltrated into the surrounding connective tissue. A large number of lymphocytes were seen among them. The proliferating and infiltrating phases of these tumours might be considered as tendencies leading towards malignancy. Rats injected with single dose of 400 μci of I-131 were reported to exhibit carcinoma of the thyroid after a lapse of about two years.[4] Though the occurrence of I-131 induced neoplasms are not well known in fishes, the present observation suggests a comparable influence of radioiodine towards the formation of benign and malignant tumours in fish and mammals probably at different dose levels.

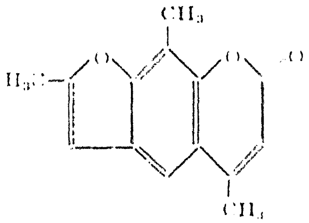
We are indebted to Dr. K. N. Udupa, Hony. Director and Dr. L. M. Singh, Officer in charge of the Laboratory and Dr. S. P. Ray-Chaudhuri, Banaras Hindu University, for providing all facilities and encouragement. The junior author is grateful to the U.G.C. for the award of a Fellowship.

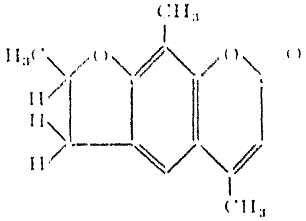
Surgical Res. Lab., A. G. SATHYANESAN.
College of Medical Sci.,
and
Department of Zoology, S. S. SRIVASTAVA.
Banaras Hindu University,
Varanasi-5, India, *February* 10, 1970.

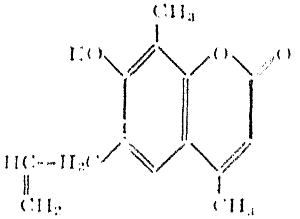
---

1. Arvy, L., Fontaine, M. and Gabe, M., *Compt. Rend. Soc. Biol.*, 1956, **150**, 625.
2. Baker-Cohen, *Zoologica*, 1961, **46**, 181.
3. Cukrowski, C. A. and Walter Chavin, *Americ. Zoologist*, **1964**, **4**, 4.
4. Goldberg, R. C. and Chaikoff, I. L., *Proc. Soc. Exptl. Biol. Med.*, **1951**, **76**, 563.
5. Linsay, S., "Pathology of the thyroid gland," In *Thyriod Gland*, Butterworths, London, 1964, **1**, 223.
6. Leloup, J. and Fontaine, M., *Ann. New York Acad. Sci.*, 1960, **86**, 316.
7. La Roche, G., Johnson, C. L. and Woodall, A. N., *Gen. Comp. Endocrinol.*, 1965, **5**, 145.
8. Norris, D. O. and Gorbman, A., *Proc. Soc. Exptl. Biol. Med.*, 1965, **119**, 1205.
9. Olivereau, M., *Arch. Anat. Micro. Morph. Exptl.*, 1957, **46**, 39.
10. Pickford, G. E. and Atz, J. W., *The Physiology of the Pituitary Gland of Fishes*, New York, Zool. Soc., New York, 1957.
11. Walter Chavin, *No. 2 Great Lake Research Division*, University of Michigan, 1964, p. 54.

by using the modified technique developed by Shaikh and Trivedi.[4] 7-Hydroxy-6-allyl-4,8-dimethylcoumarin was triturated with concentrated sulphuric acid for 10 minutes at room temperature to give 4,5′,8-trimethyl-4′,5′-dihydropsoralene (III), m.p. 176 (Found: C, 72·96%; H, 5·91%. $C_{14}H_{14}O_3$ requires C, 73·02%; H, 6·13%).


(I)


(III)


(II)

Compound (III) was dehydrogenated by refluxing it in diphenyl ether in the presence of palladised charcoal (10%) to give (I), m.p. 232° identical with the compound prepared according to Kaufman.[3]

Thanks are due to Professor S. Sethna for his keen interest in this work and to Dr. S. S. Lele for microanalysis of the sample.

Chemistry Department, M. G. Parekh.
Faculty of Science, K. N. Trivedi.
M.S. University of Baroda,
Baroda-2, *February* 25, 1970.

1. Scheel, L. D. *et al.*, *Biochemistry*, 1960, **35**, 165.
2. Pathak, M. A. *et al.*, *J. Invest. Dermatol.*, 1960, **35**, 165.
3. Kaufman, K. D., *J. Org. Chem.*, 1961, **26**, 117.
4. Shaikh, Y. A. and Trivedi, K. N., *Curr. Sci.*, 1969, **38**, 409

RADIOIODINE INDUCED THYROID TUMOURS IN THE INDIAN FRESHWATER CAT FISH *MYSTUS VITTATUS* (BLOCH.)

The thyroid gland of *M. vittatus* is in the form of scattered follicles situated around the ventral aorta and its afferent branchial arteries (Fig. 1). As such surgical extirpation of the gland is not possible. In teleosts in general, with few exceptions where the thyroid is compact, hypothyroidism is produced either by radioiodine or by chemical inhibitors. These inhibitors are frequently referred to as goitrogens[6-10] and they are known to be toxic and producing peripheral ill effects. Radiothyroidectomy has been attempted in several species of fishes using relatively large doses of I-131.[1-5, 9, 11] It is believed that radiothyroidectomy is not accompanied by detectable secondary radiation damage. Although I-131-induced tumours are rare of occurrence in fishes, in mammals radioiodine has been implicated in the development of benign and malignant thyroid neoplasm. In this study radioiodine-induced tumours showing carcinogenic tendencies in the thyroid of *M. vittatus* are described.

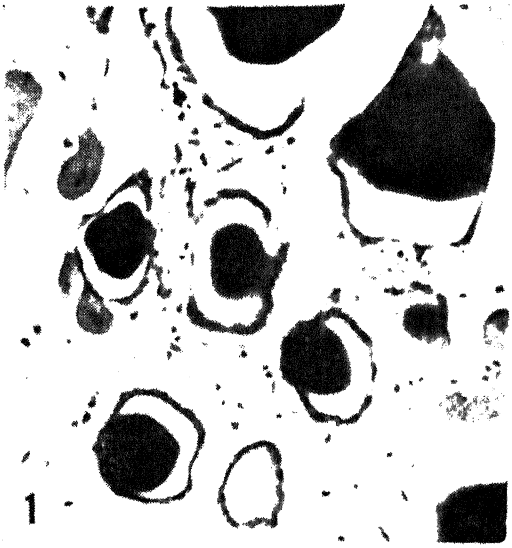


FIG. 1. Cystic thyroid after one month I-131 treatment, × 450.

Ten adult *M. vittatus* having an average length of 10 cm. and weight of 10·5 gm. were used. Six of them were given one millicurie (mCi) I-131 in single intra-peritoneal injection or in instalments of 750, 250, and 250

microcurie (μci) at intervals of 3 and 4 months. Four specimens received 750 μci in a solitary injection. They were sacrificed at intervals of one to eight months. The pharyngeal region with the thyroid follicles was fixed in Bouin's fluid, and paraffin sections were cut at 5 and 7 micra thick and stained in PAS-Haematoxylin. A fish which received one mCi in instalments exhibited several cystic tumours in the thyroid at the end of the eighth month. In the remaining treated fish, although an extensive replacement of epithelial cells with connective tissue was noticed from the second month onwards, no typical cysts were present. The tumours had a diameter range of 10 to 80 μ. Among them few scattered microfollicles with colloid also were seen (Fig. 2). These follicles were capable of trapping radioiodine. They have very low uptake value and their radioautograph is represented by few faint spots. This obviously showed that a major portion of the gland has been completely destroyed.

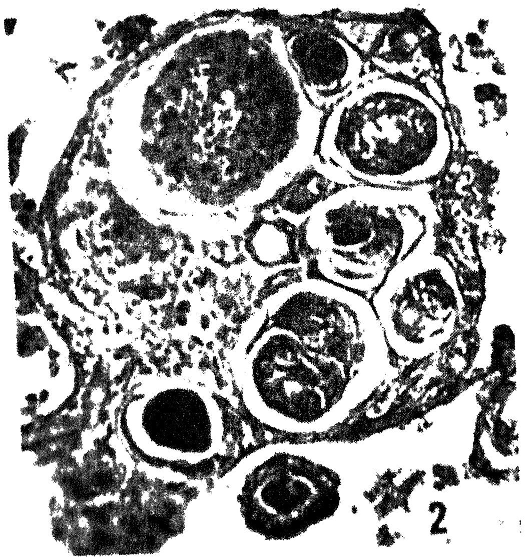


FIG. 2. Normal thyroid. Bouin's fluid : PAS Haematoxylin, × 450.

Although several of the cystic tumours were encapsulated, those without limiting capsules were also not uncommon. Their histological picture also exhibited variations. Some encapsulated tumours were fibrocellular with varying amounts of stainable debris whereas some others were in the form of solid cellular masses (Fig. 2). Oclasionally, few of them lost their capsulated nature due to active proliferation of its component cells. These proliferating cells infiltrated into the surrounding connective tissue. A large number of lymphocytes were seen among them. The proliferating and infiltrating phases of these tumours might be considered as tendencies leading towards malignancy. Rats injected with single dose of 400 μci of I-131 were reported to exhibit carcinoma of the thyroid after a lapse of about two years.[4] Though the occurrence of I-131 induced neoplasms are not well known in fishes, the present observation suggests a comparable influence of radioiodine towards the formation of benign and malignant tumours in fish and mammals probably at different dose levels.

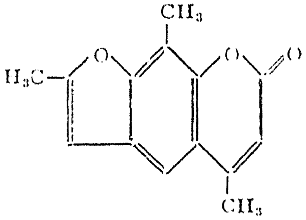
We are indebted to Dr. K. N. Udupa, Hony. Director and Dr. L. M. Singh, Officer in charge of the Laboratory and Dr. S. P. Ray-Chaudhuri, Banaras Hindu University, for providing all facilities and encouragement. The junior author is grateful to the U.G.C. for the award of a Fellowship.

Surgical Res. Lab., A. G. SATHYANESAN.
College of Medical Sci.,
and
Department of Zoology, S. S. SRIVASTAVA.
Banaras Hindu University,
Varanasi-5, India, *February* 10, 1970.

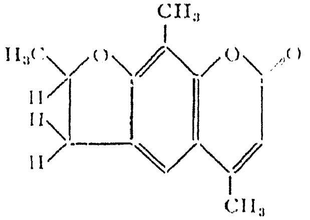
---

1. Arvy, L., Fontaine, M. and Gabe, M., *Compt. Rend. Soc. Biol.*, 1956, **150**, 625.
2. Baker Cohen, *Zoologica*, **1961**, **46**, **181**.
3. Cukrowski, C. A. and Walter Chavin, *Americ. Zoologist*, **1964**, **4**, 4.
4. Goldberg, R. C. and Chaikoff, I. L., *Proc. Soc. Exptl. Biol. Med.*, 1951, **76**, 563.
5. Linsay, S., "Pathology of the thyroid gland," In *Thyriod Gland*, Butterworths, London, 1964, **1**, 223.
6. Leloup, J. and Fontaine, M., *Ann. New York Acad. Sci.*, 1960, **86**, 316.
7. La Roche, G., Johnson, C. L. and Woodall, A. N., *Gen. Comp. Endocrinol.*, 1965, **5**, 145.
8. Norris, D. O. and Gorbman, A., *Proc. Soc. Exptl. Biol. Med.*, 1965, **119**, 1205.
9. Olivereau, M., *Arch. Anat. Micro. Morph. Exptl.*, 1957, **46**, 39.
10. Pickford, G. E. and Atz, J. W., *The Physiology of the Pituitary Gland of Fishes*, New York, Zool. Soc., New York, 1957.
11. Walter Chavin, *No. 2 Great Lake Research Division*, University of Michigan, 1964, p. 54.

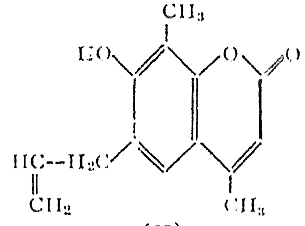
by using the modified technique developed by Shaikh and Trivedi.[4] 7-Hydroxy-6-allyl-4, 8-dimethylcoumarin was triturated with concentrated sulphuric acid for 10 minutes at room temperature to give 4, 5′, 8-trimethyl-4′, 5′-dihydropsoralene (III), m.p. 176° (Found: C, 72·96%; H, 5·91%. $C_{14}H_{14}O_3$ requires C, 73·02%; H, 6·13%).



(I)



(III)



(II)

Compound (III) was dehydrogenated by refluxing it in diphenyl ether in the presence of palladised charcoal (10%) to give (I), m.p. 232° identical with the compound prepared according to Kaufman.[3]

Thanks are due to Professor S. Sethna for his keen interest in this work and to Dr. S. S. Lele for microanalysis of the sample.

Chemistry Department, M. G. Parekh.
Faculty of Science, K. N. Trivedi.
M.S. University of Baroda,
Baroda-2, *February* 25, 1970.

---

1. Scheel, L. D. *et al.*, *Biochemistry*, 1960, **35**, 165.
2. Pathak, M. A. *et al.*, *J. Invest. Dermatol.*, 1960, **35**, 165.
3. Kaufman, K. D., *J. Org. Chem.*, 1961, **26**, 117.
4. Shaikh, Y. A. and Trivedi, K. N., *Curr. Sci.*, 1969, **38**, 409

RADIOIODINE INDUCED THYROID TUMOURS IN THE INDIAN FRESHWATER CAT FISH *MYSTUS VITTATUS* (BLOCH.)

The thyroid gland of *M. vittatus* is in the form of scattered follicles situated around the ventral aorta and its afferent branchial arteries (Fig. 1). As such surgical extirpation of the gland is not possible. In teleosts in general, with few exceptions where the thyroid is compact, hypothyroidism is produced either by radioiodine or by chemical inhibitors. These inhibitors are frequently referred to as goitrogens[6-10] and they are known to be toxic and producing peripheral ill effects. Radiothyroidectomy has been attempted in several species of fishes using relatively large doses of I-131.[1, 4, 8, 9, 11] It is believed that radiothyroidectomy is not accompanied by detectable secondary radiation damage. Although I-131-induced tumours are rare of occurrence in fishes, in mammals radioiodine has been implicated in the development of benign and malignant thyroid neoplasm. In this study radioiodine-induced tumours showing carcinogenic tendencies in the thyroid of *M. vittatus* are described.

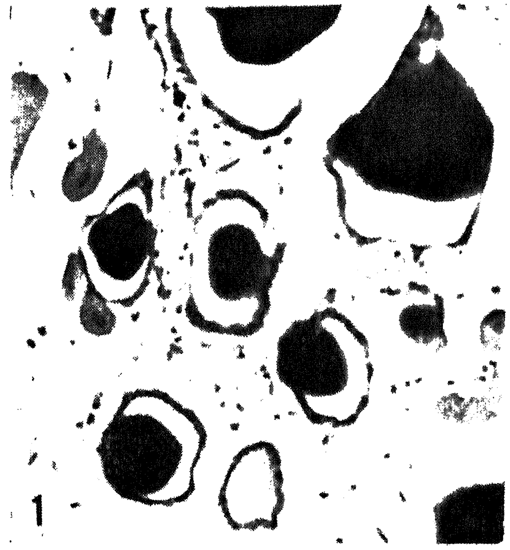


FIG. 1. Cystic thyroid after a month I 131 treatment, × 460.

Ten adult *M. vittatus* having an average length of 10 cm. and weight of 10·5 gm. were used. Six of them were given one millicurie (mCi) I-131 in single intra-peritoneal injection or in instalments of 750, 250, and 250

microcurie (μci) at intervals of 3 and 4 months. Four specimens received 750 μci in a solitary injection. They were sacrificed at intervals of one to eight months. The pharyngeal region with the thyroid follicles was fixed in Bouin's fluid, and paraffin sections were cut at 5 and 7 micra thick and stained in PAS-Haematoxylin. A fish which received one mCi in instalments exhibited several cystic tumours in the thyroid at the end of the eighth month. In the remaining treated fish, although an extensive replacement of epithelial cells with connective tissue was noticed from the second month onwards, no typical [illegible] were present. The tumours had a diameter range of 10 to 80 μ. Among them few scattered microfollicles with colloid also were seen (Fig. 2). These follicles were capable of trapping radioiodine. They have very low uptake value and their radioautograph is represented by few faint spots. The [illegible] showed that a major portion of the gland has been completely destroyed.

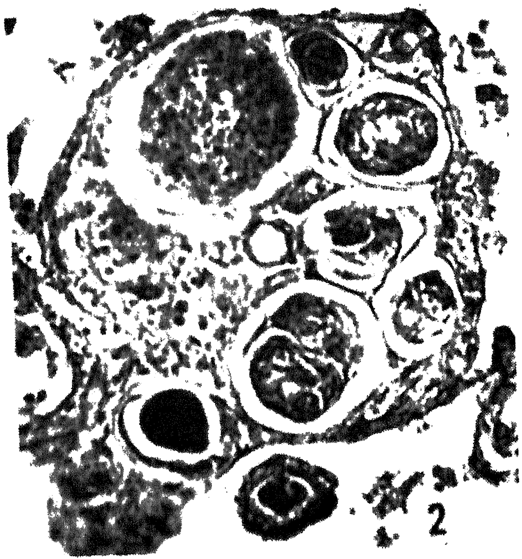


FIG. 2. Normal thyroid. Bouin's fluid; PAS-Haematoxylin, × 450.

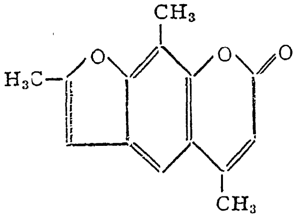
Although several of the cystic tumours were encapsulated, those without limiting capsules were also not uncommon. Their histological picture also exhibited variations. Some encapsulated tumours were fibrocellular with varying amounts of stainable debris whereas some others were in the form of solid cellular masses (Fig. 2). Occasionally, few of them lost their capsulated nature due to active proliferation of its component cells. These proliferating cells infiltrated into the surrounding connective tissue. A large number of lymphocytes were seen among them. The proliferating and infiltrating phases of these tumours might be considered as tendencies leading towards malignancy. Rats injected with single dose of 400 μci of I-131 were reported to exhibit carcinoma of the thyroid after a lapse of about two years.[4] Though the occurrence of I-131 induced neoplasms are not well known in fishes, the present observation suggests a comparable influence of radioiodine towards the formation of benign and malignant tumours in fish and mammals probably at different dose levels.

We are indebted to Dr. K. N. Udupa, Hony. Director and Dr. L. M. Singh, Officer in charge of the Laboratory and Dr. S. P. Ray-Chaudhuri, Banaras Hindu University, for providing all facilities and encouragement. The junior author is grateful to the U.G.C. for the award of a Fellowship.

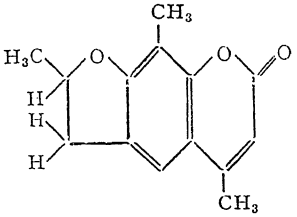
Surgical Res. Lab., A. G. SATHYANESAN.
College of Medical Sci.,
and
Department of Zoology, S. S. SRIVASTAVA.
Banaras Hindu University,
Varanasi-5, India, *February* 10, 1970.

1. Arvy, L., Fontaine, M. and Gabe, M., *Compt. Rend. Soc. Biol.*, 1956, **150**, 625.
2. Baker Cohen, *Zoologica*, 1961, **46**, 181.
3. Cukrowski, C. A. and Walter Chavin, *Americ. Zoologist*, 1964, **4**, 4.
4. Goldberg, R. C. and Chaikoff, I. L., *Proc. Soc. Exptl. Biol. Med.*, 1951, **76**, 563.
5. Linsay, S., "Pathology of the thyroid gland," In *Thyroid Gland*, Butterworths, London, 1964, **1**, 223.
6. Leloup, J. and Fontaine, M., *Ann. New York Acad. Sci.*, 1960, **86**, 316.
7. La Roche, G., Johnson, C. L. and Woodall, A. N., *Gen. Comp. Endocrinol.*, 1965, **5**, 145.
8. Norris, D. O. and Gorbman, A., *Proc. Soc. Exptl. Biol. Med.*, 1965, **119**, 1205.
9. Olivereau, M., *Arch. Anat. Micro. Morph. Exptl.*, 1957, **46**, 39.
10. Pickford, G. E. and Atz, J. W., *The Physiology of the Pituitary Gland of Fishes*, New York, Zool. Soc., New York, 1957.
11. Walter Chavin, *No. 2 Great Lake Research Division*, University of Michigan, 1964, p. 54.

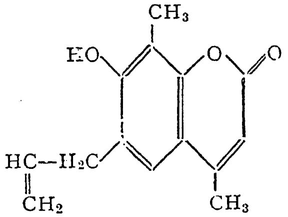
by using the modified technique developed by Shaikh and Trivedi.[4] 7-Hydroxy-6-allyl-4,8-dimethylcoumarin was triturated with concentrated sulphuric acid for 10 minutes at room temperature to give 4, 5′, 8-trimethyl-4′, 5′-dihydropsoralene (III), m.p. 176° (Found: C, 72·96%; H, 5·91%. $C_{14}H_{14}O_3$ requires C, 73·02%; H, 6·13%).



(I)



(III)



(II)

Compound (III) was dehydrogenated by refluxing it in diphenyl ether in the presence of palladised charcoal (10%) to give (I), m.p. 232° identical with the compound prepared according to Kaufman.[3]

Thanks are due to Professor S. Sethna for his keen interest in this work and to Dr. S. S. Lele for microanalysis of the sample.

Chemistry Department, Faculty of Science, M.S. University of Baroda, Baroda-2, *February* 25, 1970.

M. G. PAREKH.
K. N. TRIVEDI.

---

1. Scheel, L. D. *et al.*, *Biochemistry*, 1960, **35**, 165.
2. Pathak, M. A. *et al.*, *J. Invest. Dermatol.*, 1960, **35**, 165.
3. Kaufman, K. D., *J. Org. Chem.*, 1961, **26**, 117.
4. Shaikh, Y. A. and Trivedi, K. N., *Curr. Sci.*, 1969, **38**, 409

RADIOIODINE INDUCED THYROID TUMOURS IN THE INDIAN FRESHWATER CAT-FISH *MYSTUS VITTATUS* (BLOCH.)

THE thyroid gland of *M. vittatus* is in the form of scattered follicles situated around the ventral aorta and its afferent branchial arteries (Fig. 1). As such surgical extirpation of the gland is not possible. In teleosts in general, with few exceptions where the thyroid is compact, hypothyroidism is produced either by radioiodine or by chemical inhibitors. These inhibitors are frequently referred to as goitrogens[6-10] and they are known to be toxic and producing peripheral ill-effects.[7] Radiothyroidectomy has been attempted in several species of fishes using relatively large doses of I-131.[1-3,8,9,11] It is believed that radiothyroidectomy is not accompanied by detectable secondary radiation damage.[2,7] Although I-131-induced tumours are rare of occurrence in fishes, in mammals radioiodine has been implicated in the development of benign and malignant thyroid neoplasm.[5] In this study radioiodine-induced tumours showing carcinogenic tendencies in the thyroid of *M. vittatus* are described.

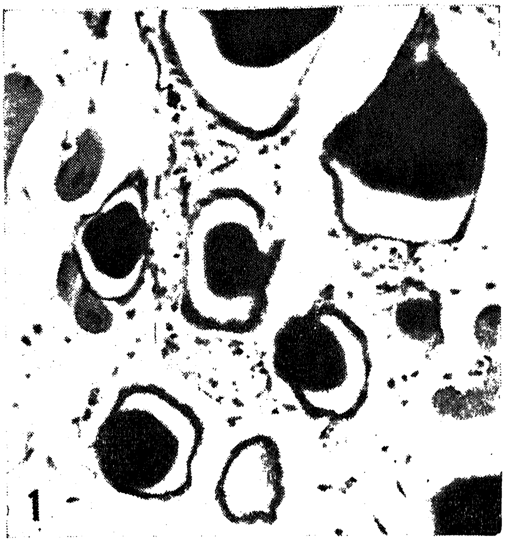


FIG. 1. Cystic thyroid after one mCi I-131 treatment, × 450.

Ten adult *M. vittatus* having an average length of 10 cm. and weight of 10·5 gm. were used. Six of them were given one millicurie (mCi) I-131 in single intra-peritoneal injection or in instalments of 750, 250, and 250

microcurie (μci) at intervals of 3 and 4 months. Four specimens received 750 μci in a solitary injection. They were sacrificed at intervals of one to eight months. The pharyngeal region with the thyroid follicles was fixed in Bouin's fluid, and paraffin sections were cut at 5 and 7 micra thick and stained in PAS-Hæmatoxylin. A fish which received one mCi in instalments exhibited several cystic tumours in the thyroid at the end of the eighth month. In the remaining treated fish, although an extensive replacement of epithelial cells with connective tissue was noticed from the second month onwards, no typical cysts were present. The tumours had a diameter range of 10 to 80 μ. Among them few scattered microfollicles with colloid also were seen (Fig. 2). These follicles were capable of trapping radioiodine. They have very low uptake value and their radioautograph is represented by few faint spots. This obviously showed that a major portion of the gland has been completely destroyed.

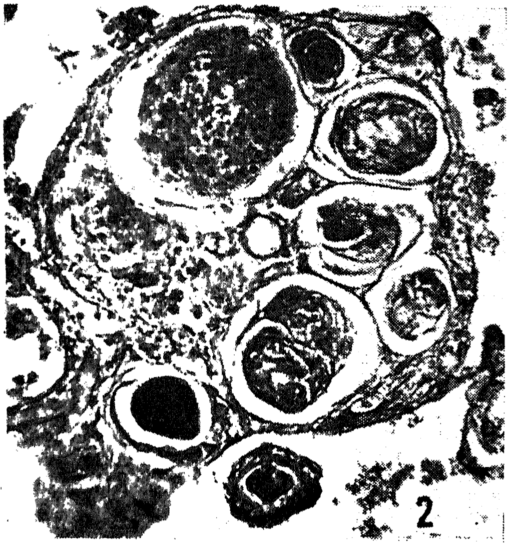


FIG. 2. Normal thyroid. Bouin's fluid : PAS-Hæmatoxylin, × 450.

Although several of the cystic tumours were encapsulated, those without limiting capsules were also not uncommon. Their histological picture also exhibited variations. Some encapsulated tumours were fibrocellular with varying amounts of stainable debris whereas some others were in the form of solid cellular masses (Fig. 2). Oclasionally, few of them lost their capsulated nature due to active proliferation of its component cells. These proliferating cells infiltrated into the surrounding connective tissue. A large number of lymphocytes were seen among them. The proliferating and infiltrating phases of these tumours might be considered as tendencies leading towards malignancy. Rats injected with single dose of 400 μci of I-131 were reported to exhibit carcinoma of the thyroid after a lapse of about two years.[4] Though the occurrence of I-131 induced neoplasms are not well known in fishes, the present observation suggests a comparable influence of radioiodine towards the formation of benign and malignant tumours in fish and mammals probably at different dose levels.

We are indebted to Dr. K. N. Udupa, Hony. Director and Dr. L. M. Singh, Officer in charge of the Laboratory and Dr. S. P. Ray-Chaudhuri, Banaras Hindu University, for providing all facilities and encouragement. The junior author is grateful to the U.G.C. for the award of a Fellowship.

Surgical Res. Lab., A. G. SATHYANESAN.
College of Medical Sci.,
and
Department of Zoology, S. S. SRIVASTAVA.
Banaras Hindu University,
Varanasi-5, India, *February* 10, 1970.

---

1. Arvy, L., Fontaine, M. and Gabe, M., *Compt. Rend. Soc. Biol.*, 1956, **150**, 625.
2. Baker-Cohen, *Zoologica*, 1961, **46**, 181.
3. Cukrowski, C. A. and Walter Chavin, *Americ. Zoologist*, 1964, **4**, 4.
4. Goldberg, R. C. and Chaikoff, I. L., *Proc. Soc. Exptl. Biol. Med.*, 1951, **76**, 563.
5. Linsay, S., "Pathology of the thyroid gland," In *Thyriod Gland*, Butterworths, London, 1964, **1**, 223.
6. Leloup, J. and Fontaine, M., *Ann. New York Acad. Sci.*, 1960, **86**, 316.
7. La Roche, G., Johnson, C. L. and Woodall, A. N., *Gen. Comp. Endocrinol.*, 1965, **5**, 145.
8. Norris, D. O. and Gorbman, A., *Proc. Soc. Exptl. Biol. Med.*, 1965, **119**, 1205.
9. Olivereau, M., *Arch. Anat. Micro. Morph. Exptl.*, 1957, **46**, 39.
10. Pickford, G. E. and Atz, J. W., *The Physiology of the Pituitary Gland of Fishes*, New York, Zool. Soc., New York, 1957.
11. Walter Chavin, *No. 2 Great Lake Research Division*, University of Michigan, 1964, p. 54.

NOTE ON THE OCCURRENCE OF *BALANTIDIUM ROTUNDUM* BEZZENBERGER (PROTOZOA, CILIATA) IN *RANA TIGRINA* DAUDIN FROM WEST BENGAL, INDIA

WHILE examining the rectal contents of a common frog *Rana tigrina* Daudin collected from Behala, Dist. 24 Parganas, West Bengal, India, three examples of a ciliate were encountered. On closer examination the specimens were found to belong to the species *Balantidium rotundum* Bezzenberger. No other species of Protozoa were observed along with these specimens.

The following observations are based partly on the study of the living forms and partly on the study of the fixed and stained examples. For fixing, Schaudinn's fluid was used and followed by staining in Heidenhain's iron-hæmatoxylin and counterstained in eosin.

Body of the ciliate is more or less round measuring 48 × 39 μ in size (56 × 44 μ by Bezzenberger[1]) with a distinct thicker zone in the anterior region. The peristome extends 22 μ in length. The macronucleus is roughly kidney-shaped measuring 14 × 8 μ with a small oval micronucleus embedded in its notch. The contractile vacuole is just above the posterior end and lies on the half opposite to that having the macronucleus in the same level.

A review of the literature reveals that this species is a rare one and the only known record is by the original author of the species from the host *Rana esculenta* var. *chinensis* Osbeck from Asia without citing any specific locality (Bhatia[2]). Boulenger[3] gives the area of the distribution of this host as Amoor Province of Siberia, Saghalien Island, Japan, Korea, Mongolia, China. It seems that this particular host is not recorded from the Indian sub-continent. This note is to place on record the proven occurrence of this species *Balantidium rotundum* Bezzenberger from the Indian sub-continent and from a new host *Rana tigrina* Daudin.

Our thanks are due to the Director, Zoological Survey of India for the facilities provided and for permission to publish this note.

Zool. Survey of India, K. N. NAIR.
Calcutta, *January* 31, 1970. R. N. MUKHERJEE.

---

1. Bezzenberger, E., *Arch. Protistenk.*, Jena, 1904, 3, 153.
2. Bhatia, B. L., *Fauna of British India*, Protozoa: Ciliophora, Taylor & Francis, London, 1936.
3. Boulenger, G. A., *Res. Indian Mus.*, Delhi, 1920, p. 88.

OCCURRENCE OF THE TADPOLE SHRIMP *TRIOPS LONGICAUDATUS* (BRANCHIOPODA : NOTOSTRACA) IN SOUTHERN INDIA

AMONG the Branchiopod crustaceans the Order Notostraca has only two genera, *Triops* (*Apus*) and *Lepidurus* which show world-wide distribution and inhabit temporary fresh or brackish-water pools. Tiwari (1952), while reviewing the Indian species under the genus *Apus*, gave a detailed account of all then known species including two new species. Earlier Chacko (1950) recorded the occurrence of a single male of *Apus* in South India which was given the name *Apus* sp. *prox sudanicus* by Tiwari (1952) because of its close resemblance to *Apus sudanicus* Brauer. The present record of *Triops* is from two seasonal tanks located in Sawyerpuram near Tuticorin (lat. 8° 48′ N., long. 78° 10′ E.) on the Southeastern part of India. Sawyerpuram is at a distance of only 6 miles across the land from the Eastern seacoast of India. In one of these ponds 24 animals belonging to both sexes were collected for the first time when water was drying up. In both the ponds three days after the next rains these organisms appeared and these were observed almost daily by making collections. These populations remained in very low densities and for only a brief period of 14 days, within which they reached a maximum size of 17·5 mm. in carapace length. A total of 48 animals of different sizes and various developmental stages were studied in detail.

Tiwari (1952), among several of other characters, used mainly the shape of carapace and nuchal organ, number of apodous segments and the total number of movable segments for the specific diagnosis of *Triops*. Longhurst (1955) assigned all known species of *Triops* into four groups each with a geographical basis. His detailed work based on the study and development of various species of *Triops* led him to conclude that "the valid characters appear to be the armature of the telson, the presence or absence of second maxilla and the arrangement of the eyes and dorsal organ. Of these, the most important is the armature of the telson which is diagnostic of each group". Using these criteria all the other Indian species have been put under *Triops granarius* (Lucas) retaining only *Triops cancriformis* as the only other valid species (Longhurst, 1955).

All the adults in the present collections (15·0 mm. to 17·5 mm. carapace length) have the large post-marginal spines in the telson set well forward of the margin which is said to be a unique feature of *Triops longicaudatus* (Longhurst, 1955). The structure of the carapace, the number of body segments, supernumerary spines of the ventral surface and the shape of the eyes and dorsal organ also correspond to those of *T. longicaudatus*. However, the present species have well developed second maxilla, while it is absent in *T. longicaudatus* (Longhurst, *loc. cit.*). In this character, it resembles *Triops granarius* as also in the number, size and arrangement of median spines in the telson. In view of this combination of characters of *T. longicaudatus* and *T. granarius*, the present species has been designated as *Triops longicaudatus granarius* thus giving it the status of a sub-species.

T. longicaudatus has not so far been reported from India as its earlier records are from Western North America—South of 50° N, through Central to South America, West Indies, Galapagos Islands, Hawaii, Japan and New Caledonia. Hence the present record of this species in the Peninsular India raises interesting questions on the zoogeographic distribution of this species. Nevertheless, it is not altogether surprising, since the species of Notostraca are so widespread and their dried resistant eggs could passively be distributed over long distances which otherwise act as geographical barriers for other species.

The author expresses his gratitude to Professor S. Krishnasamy and Dr. R. George Michael, Department of Biological Sciences, Madurai University, Madurai, for all the help in the preparation of this paper. He is also thankful to his Principal, Mr. D. S. George Muller, for his encouragement and help.

Department of Biology, M. P. LAMBERT ISAAC.
Pope's College,
Sawyerpuram, South India,
March 20, 1970.

---

1. Tiwari, K. K., *Rec. Ind. Mus.*, 1952, **49**, 197.
2. Chacko, P. I., *Jour. Bombay Nat. Hist. Soc.*, 1950, **49**, 571.
3. Longhurst, A. R., *Bull. British Mus. Nat. Hist.*, 1955, **3**, 57.

ON *CENTROSEMA VIRGINIANUM* (LINN.) BENTH. IN INDIA

Centrosema virginianum (Linn.) Benth. a perennial climber with beautiful violet flowers is a native of Virginia. It has been introduced and cultivated in gardens in America as an ornamental climber (Bailey, 1942).

This plant was brought into India as early as 1807 when C. Creville handed over this to William Roxburgh who was then the Superintendent of the East India Company's botanical garden at Sibpur, Howrah (the present Indian Botanic Garden). It was under cultivation for nearly 40 years as is evidenced by the mention of this plant in *Hortus Bengalensis* (1814) and *Hortus Suburbanus Calcuttensis* (1845).

In 1961, Subramanian found this climber growing in populations in the Tenmalai forest, Kerala and Coorg forests in Mysore. This is the first record of this climber under wild condition. It is rather difficult to explain how this exotic came into the forests of Western Ghats. Recently, it has been found growing as an escape in Pasighat, 24 Parganas District, W. Bengal, under wild condition. Its occurrence therefore constitutes a second record of this plant in a wild condition and first of its kind in W. Bengal. It is remarkable that the plant has made its appearance after more than 100 years when it first came to India as a cultigen in the Sibpur Botanical Garden, Howrah.

In America (Bailey, 1942) a white-flowered form is regarded as a good horticultural variety. Hence the plant has great potentials of being tried as a good horticultural variety. For a detailed description of the plant with an illustration see reference of Subramanian (1962).

Distribution : Kerala, Mysore and W. Bengal.

Specimens examined : Pasighat, 24 Parganas, 14-4-1969, *Sarkar* s.n. (CAL).

Central National Herbarium, K. THOTHATHRI.
Indian Botanic Garden, R. PRASAD.
Howrah, *January* 31, 1970.

---

1. Bailey, L. H., *Standard Cyclopædia of Horticulture*, 1942, **1**, 714.
2. Roxburgh, W., *Hortus Bengalensis*, 1814, p. 15.
3. Subramanian, K. N., "A note on *Centrosema virginianum* (L.) Benth.," *Bull. bot. Surv. India*, 1962, **3**, 201.
4. Voigt, J. O., *Hortus Suburbanus Calcuttensis*, 1845, p. 213.

THE CHEMICAL NATURE OF ORGANIC COMPLEXES IN KERALA SOILS

THE soils of Kerala State generally contain a relatively high proportion of organic matter. To study the exact nature of the organic complexes existing in these soils, four typical soils were collected from different parts of the State and the organic matter in them was fractionated into seven groups of compounds by the scheme suggested by Waksman and Stevens.[1]

TABLE I

Description and chemical characteristics of the soils

No.	Locality		Description	Depth cm.	pH	On moisture-free basis: Inorganic matter %	C %	N %	C/N
1	Purakad	..	*Kari* (Peaty) soil	0–25	3·1	68·5	9·90	0·58	17·1
2	Thottappally	..	do.	0–25	4·0	73·8	8·76	0·37	23·7
3	Changanacherry	..	Submerged rice soil	0–25	4·2	84·4	4·38	0·36	12·2
4	Konni	..	Virgin forest soil	0–25	5·8	81·4	5·64	0·24	23·5

TABLE II

Proximate chemical composition of soil organic matter (Per cent of total organic matter accounted for)

No.	Locality		Ether extract	Water solubles	Alcohol solubles	Hemicellulose	Cellulose	Lignin	Protein
1	Purakad	..	4·83	8·19	4·52	0	0	68·54	13·92
2	Thottappally	..	7·29	0·71	8·09	0	0	72·37	11·54
3	Changanacherry	..	2·07	2·73	2·63	Trace	2·82	68·51	21·24
4	Konni	..	1·03	2·15	1·27	0·09	3·87	78·85	12·64

The description and chemical characteristics of the soils studied are given in Table I and the results of fractionation in Table II.

It may be observed from the tables that these soils are characterised by wide C/N ratios varying from 12·17% in the submerged rice soil from Changanacherry to 23·67% in the *Kari* soil from Thottappally. The major organic fraction in all the soils is lignin which ranges from 68·51% in the soil from Changanacherry to 78·85% in the virgin forest soil from Konni. With the exception of the Changanacherry soil the protein content of the soil organic matter is rather constant and varies between 11·54% and 13·37%. In the soil from Changanacherry this fraction is as high as 21·24%.

Further, it is seen that the organic matter of the *Kari* soils is remarkable in two respects, *viz.*, the entire absence of hemi-cellulose and cellulose and a preponderance of the ether and alcohol extractives. Pillai and Subramanyan[2] point out that in certain respects the *Kari* soils of Kerala are similar to the low moor peats of the temperate regions studied by Waksman and Stevens,[1] although there are marked differences between the two. The absence of hemi-cellulose and cellulose in *Kari* soils is to be attributed to the long-time microbiological activity to which these soils have been subjected. The relatively higher percentage of ether and alcohol-soluble compounds may also be attributed to the same cause which has brought about the synthesis and accumulation of compounds soluble in these solvents.

Division of Agricultural Chemistry, M. M. Koshy
Agricultural College and Res. Inst.,
Vellayani, *January* 28, 1970.

---

1. Waksman, S. A. and Stevens, K. R., *Soil Sci.*, 1928, **26**, 113.
2. Pillai, T. R. N. and Subramanyan, V., *J. Ind. Inst. Sci.*, 1931, **14 A**, 99.

PRODUCTION OF POLYPETALOUS FLOWERS IN SNAPDRAGON IN RESPONSE TO ADDED MORPHACTIN

RECENTLY, morphactins (derivatives of fluorine-9-carboxylic acid) have evoked considerable interest as novel growth regulators which actively influence growth and morphogenesis in higher plants.[1-4] The present report concerns the effect of morphactin on growth and floral morphogenesis of snapdragon.

Twenthy-five days old seedlings of snapdragon in earthenware pots were sprayed with 50 ml. solution of desired concentration of morphactin (IT 3233) obtained from Merck AG, Germany. A week later a second spray was made using an equivalent amount of solution so as to give a total of 0·5, 1 or 2 mg. of morphactin. Even in the plants receiving only 0·5 mg. morphactin the dormancy of the lateral buds was almost completely released, and the treated plants developed several lateral branches. The further growth of these branches, however, remained arrested for a considerable time. On the other hand, plants receiving 1 mg. or more of morphactin indicated markedly abnormal development. Within a week after treatment the leaves of such plants rolled in and developed a high degree of succulence—a characteristic completely lacking in the leaves of the control plants. Concomitant with this change in leaf morphology, further modifications in the plant growth as a whole were also clearly evident. The elongation of the main shoot was greatly suppressed and several short lateral branches bearing succulent leaves developed on the main axis. About 1½ months after treatment, when presumably the effect of the chemical no longer existed, these branches also started growing normally and developed normal leaves and flowers. In plants receiving 2 mg. morphactin the visible appearance of the floral primordia was greatly delayed, and these plants indicated a tendency of producing polypetalous flowers (Fig. 1, A, B) instead of the normal bilabiate and gamopetalous ones. Furthermore in the treated plants the flowers were often found to be devoid of anthers or developed only a few degenerated stamens.

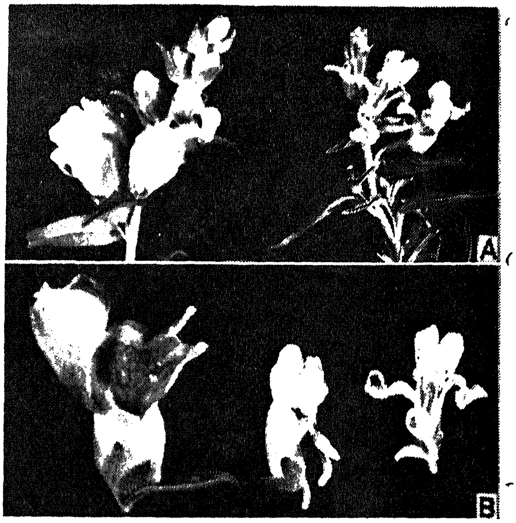


FIG. 1. A (*From L to R*)—Control and treated inflorescences. B (*From L to R*)—Flowers in control and treated plants.

The exact mode of action of morphactins remains yet to be explored. Recent evidences, however, indicate that these chemicals disturb the normal path of auxin transport and may also affect an "endogenous growth regulator gradient" to proceed smoothly.[5,6] Since many flowers in morphactin-treated plants fail to produce stamen, it would appear possible that auxin metabolism is being effected.[7,8] However, it is not possible to interpret the formation of polypetalous flowers on the basis of the effect of the morphactin on auxin metabolism alone. Further experiments are necessary to find out how morphactin brings about the formation of polypetalous flowers.

Botany Department, NARENDRA SANKHLA.
University of Jodhpur,
Jodhpur, *January* 22, 1970.

---

1. Schneider, G., Mohr, G. and Erdmann, D., *Merck Blatter*, 1967, **17**, 21.
2. Sankhla, N. and Sankhla, D., *Planta*, 1967, **76**, 47.
3. Sankhla, D. and Sankhla, N., *Biol. Plant.*, 1968, **9**, 37.
4. — and —, *Arabid. Inf. Serv.*, 1968, **5**, 21.
5. Krelle, E. and Libbert, E., *Planta*, 1967, **76**, 179.
6. Bopp, M., In *Erstes Symp. Über Morphaktine (Kurzfassungen)*, Darmstadt, 1968, p. 7.
7. Galun, E., *Phyton*, 1959, **13**, 1.
8. Sankhla, N., *Zeit. Pflanzenphysiol.*, 1969, **61**, 390.

A NEW PLANKTONIC FORAMINIFERA FROM THE LAKI (YPRESIAN) OF RAJASTHAN, INDIA

DURING the study of the microfaunal assemblage of the Kirthar (Lutetian) beds of Rajasthan, the authors have come across a number of forms which could not be assigned to any of the so far described genera, unless the generic diagnosis is greatly extended, consequently a number of new genera have been proposed which have either been published or are under publication.

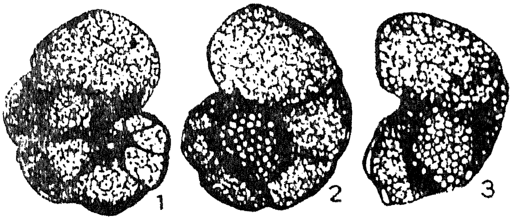
The family Indicolidæ Singh and Kalia, 1970,[1] was proposed to receive the new planktonic genus *Indicola* Singh and Kalia, and in the same paper an attempt was made to establish its phylogenetic relationship with the other families of the superfamily Globigerinacea. In order to get further data for confirming and supplementing the proposed family phylogeny of the Indicolidae, the detailed microfaunal study of the underlying Laki (Ypresian) beds was taken up and during the study, the authors have come across another new form described in this note. The new genus *Praeindicola* on the basis of the characteristic features, namely, the interiomarginal primary multiple aperture and the umbilical infilling, has been assigned to the family Indicolidae Singh and Kalia and seems to be the fore-runner of the genus *Indicola* Singh and Kalia.

SYSTEMATIC DESCRIPTION

Superfamily Globigerinacea Carpenter, Parker and Jones, 1862.

Family Indicolidae Singh and Kalia, 1970.

Genus *Pracindicola* Singh and Kalia, n. gen.
(FIGS. 1-3)



FIGS. 1-3. Fig. 1. Dorsal view, × 120. Fig. 2. Ventral view, × 120. Fig. 3. Lateral view, × 120.

Generic diagnosis. Test free, trochospiral; periphery broadly truncated, keeled; chambers globular to subglobular, few, enlarging rapidly; umbilicus filled with undifferentiated filamentous mass; primary aperture interiomarginal multiple; wall calcareous perforate; radial bilamellar in microstructure; surface structure distinctly favose.

Comparison and Remarks. The present genus differs from all other genera described under the Globigerinacea in possessing the primary interiomarginal multiple aperture and the infilling of the umbilical space, except with the genus *Indicola* Singh and Kalia, 1970, with which it differs in certain details of the test morphology. *Pracindicola* n. gen. has a close superficial resemblance with the eponidid genera *Neocribrella* Cushman, 1928, *Cincoriola* Haque, 1958, and *Hofkerina* Chapmann and Parr 1931, but differs from them particularly in possessing multiple primary aperture interiomarginal in position. *Cincoriola* Haque described from the Ranikot (Palaeocene) of West Pakistan seems to be the nearest comparable genus, but in the absence of any information about the detailed microstructure of its wall and the nature of the umbilical infilling, an attempt to compare with it is rather difficult. However, there is every possibility that after a detailed restudy, the genus *Cincoriola* Haque may prove to be the earliest members of the family Indicolidæ.

Type locality.—6 kilometers west of Shri Kolayatji, near Fuller's earth quarry, Bikaner, Rajasthan, India.

Type horizon.—Ostracod Zone, Kolayatji stage, Laki series (Ypresian).

Department of Geology, S. N. SINGH.
University of Lucknow,
Lucknow-7.
and
Geology Department, PRABHA KALIA.
Delhi University, Delhi-7, *May* 26, 1970.

---

1. Singh, S. N. and Kalia, Prabha, "Micropaleontology," *Amer. Mus. Nat. Hist.* New York, U.S.A., Jan., 1970, **16** (1), 76, Pls. 1-2.

HAEMONCHUS CONTORTUS (RUDOLPHI, 1802) COBB, 1898 FROM AN INDIAN ELEPHANT IN MYSORE

AN Indian elephant which was captured on 9-3-1969 died at Kalhalla, S. Coorg, Mysore State, on 31-12-1969. The elephant had been weak from the time of its capture and there were swellings on the ventral aspect of neck and abdomen which had disappeared after treatment. The postmortem was conducted on 1-1-1970 and numerous nematodes and bots were collected from the intestine and stomach respectively.

In India the parasites of the elephant have been recorded and described by Lane (1914, 1921), Ware (1924), Bhale Rao (1935), Ramanujachari and Alwar (1954) and Mair and Singh (1958). Immature specimens of a species of *Choniangium* were recorded by Ware (1924), from nodules in the wall of large intestine of an elephant at Coorg, Mysore State, whose specific identity was not established.

In the present study the following five species were identified:

1. *Haemonchus contortus* (Rudolphi, 1802) Cobb, 1898.
2. *Murshidia indica* Ware, 1924.
3. *Quilonia travancra* Lane, 1914.
4. *Equinubria sipunculiformis* (Baird, 1859) Lane, 1914.
5. *Choniangium magnostomum* Westhuysen, 1938.

The bots were identified as *Cobboldia elephantis* (Cobbold, 1866).

The identification was based on the descriptions given by Westhuyzen (1938), Skrjabin (1952), Soulsby (1968), and Sen and Fletcher (1962).

This is the first record of *H. contortus* among the parasites of the elephant so far described and no other Trichostrongylid worm has been recorded in this animal.

The authors are grateful to Dr. K. S. Hegde, Professor of Parasitology, Veterinary College, for his helpful guidance, to Dr. N. S. Krishna Rao for his help in writing this note and to Dr. R. D. Nanjiah, Director of Instruction,

Veterinary College, University of Agricultural Sciences, for the encouragement given.

S. ABDUL RAHMAN.*
K. R. SUKUMARA PILLAY.**
B. V. PREMA.‡
M. NARAYANASWAMY.‡

February 27, 1970.

---

* Department of Parasitology, Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-24 (Mysore State).

** Veterinary Assistant Surgeon, Pollibetta, S. Coorg (Mysore State).

‡ Mysore Serum Institute, Hebbal, Bangalore-24.

1. Bhale Rao, G. D., *Ind. J. Vet. Sci. and A.H.*, March **1935**, **5**, Part I.
2. Lane, C., *Ind. J. Med. Res.*, 1914, **2**, 380.
3. —, *Ibid.*, 1921, **9**, 163.
4. Malik, B. S. and Singh, G., *Proc. Nat. Acad. Sci. (India)*, Allahabad, 1958, **28**, Sec. B, Part II, 191.
5. Ramanujachari, G. and Alwar, V. S., *Ind. Vet. J.*, 1954, **31**, **37**.
6. Sen, S. K. and Fletcher, T. B., *Veterinary Entomology and Acarology for India*, Indian Council of Agricultural Research, New Delhi, 1962.
7. Skrjabin, K. I., *Key to Parasitic Nematodes* (English translation by Israel Program for Scientific Translation, Jerusalem, 1961), Vol. 3, 1952.
8. Soulsby, E. J. L., *Helminths, Arthropods and Protozoa of Domesticated Animals*, Bailliere, Tindall and Cassell, London, 1968.
9. Ware, F., *J. Comp. Path. Therap.*, 1924, **37**, 278.
10. Westhuysen, O. P. V., *Onderst. J. Vet. Sci. and A.H.*, 1938, **10**, 49.

REVIEWS AND NOTICES OF BOOKS

British Medical Bulletin : Immunization against Infectious Diseases. Scientific Editor D. G. Evans. (Published by the Medical Department, The British Council, 97 and 99, Park Street, London, W. 1), 1969. Pp. 100. Price £2.

This Bulletin under review contains the following articles: Introduction, by D. G. Evans; World Problems in Viral Vaccines, by W. Chas. Cockburn; The Search for Protective Antigens, by Harry Smith; Immunization Against Smallpox, by C. Kaplan; Rabies Vaccines, by G. S. Turner; Arbovirus Vaccines, by C. E. Gordon Smith; Immunization Against Poliomyelitis, by A. J. Beale; Measles Vaccines, by J. A. Dudgeon; Rubella Vaccines, by J. A. Dugein; Vaccination Against Respiratory Viruses, by D. A. J. Tyrrell; Rickettsial Vaccines, by J. H. S. Gear; Diphtheria and Tetanus Toxoids, by J. W. G. Smith; B.C.G. Vaccination in Mycobacterial Infections, by R. J. W. Rees; Pertussis, TAB and Cholera Vaccines, by A. F. B. Standfast; Immunization Against Protozoal Diseases, by R. A. Neal, P. C. C. Garnham and S. Cohen; Human Immunoglobulin in Prophylaxis, by T. M. Pollock; and Safety of Vaccines, by F. T. Perkins.

C. V. R.

Principles of Dispersal in Higher Plants. By L. van der Pijl. (Springer-Verlag, Berlin, Heidelberg and New York), 1969. Pp. vii + 154. Price DM 36; U.S. $9.00.

The work offered here is a companion volume to the work by K. Faegri and L. van der Pijl *Principles of Pollination Ecology*, which deals with the preceding phase of reproduction in plants.

In the present work too, the emphasis is on principles and ecology. It is neither an enumeration of mechanisms, nor a compilation of cases. Ridley's monumental work, *The Dispersal of Plants Throughout the World*, already compresses 700 large pages of small print, and research has proceeded since then. Though this work is more than just a compilation and contains much insight and thoughts on principles in addition to reviews, its completeness hinders its use as a text-book. As a reference work, it is unsurpassed and the writer made frequent use of it.

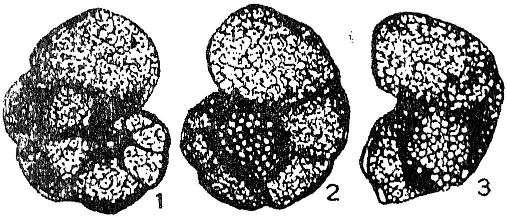
The contents of this book are: I. Introduction; II. General Terminology; III. The Units of Dispersal; IV. The Relation between Flowers, Seeds and Fruits; V. Ecological Dispersal Classes, Established on the Basis of the Dispersing Agents; VI. Combination, Limitation and Cooperation; VII. Establishment; VIII. The Evolution of Dispersal Organs; IX. Ecological Developments in Leguminous Fruits; and X. Man and His Plants.

C. V. R.

Ornamental Bulbous Plants. By S. L. Jindal. (Indian Council of Agricultural Research, New Delhi), 1968. Pp. xvii + 190. Price Rs. 19·75.

Bulbous plants constitute one of the most important groups of the floral wealth of the

Genus *Praeindicola* Singh and Kalia, n. gen.
(FIGS. 1-3)



FIGS. 1-3. Fig. 1. Dorsal view, × 120. Fig. 2. Ventral view, × 120. Fig. 3. Lateral view, × 120.

Generic diagnosis.—Test free, trochospiral; periphery broadly truncated, keeled; chambers globular to subglobular, few, enlarging rapidly; umbilicus filled with undifferentiated filamentous mass; primary aperture interiomarginal multiple; wall calcareous perforate; radial bilamellar in microstructure; surface structure distinctly favose.

Comparison and Remarks.—The present genus differs from all other genera described under the Globigerinacea in possessing the primary interiomarginal multiple aperture and the infilling of the umbilical space, except with the genus *Indicola* Singh and Kalia, 1970, with which it differs in certain details of the test morphology. *Praeindicola* n. gen. has a close superficial resemblance with the eponidid genera *Neocribrella* Cushman, 1928, *Cincoriola* Haque, 1958, and *Hofkerina* Chapmann and Parr 1931, but differs from them particularly in possessing multiple primary aperture interiomarginal in position. *Cincoriola* Haque described from the Ranikot (Palaeocene) of West Pakistan seems to be the nearest comparable genus, but in the absence of any information about the detailed microstructure of its wall and the nature of the umbilical infilling, an attempt to compare with it is rather difficult. However, there is every possibility that after a detailed restudy, the genus *Cincoriola* Haque may prove to be the earliest members of the family Indicolidæ.

Type locality.—6 kilometers west of Shri Kolayatji, near Fuller's earth quarry, Bikaner, Rajasthan, India.

Type horizon.—Ostracod Zone, Kolayatji stage, Laki series (Ypresian).

Department of Geology,
University of Lucknow,
Lucknow-7.
S. N. SINGH.
and
Geology Department,
Delhi University, Delhi-7,
PRABHA KALIA.

May 26, 1970.

---

1. Singh, S. N. and Kalia, Prabha, "Micropaleontology," *Amer. Mus. Nat. Hist.* New York, U.S.A., Jan., 1970, **16** (1), 76, Pls. 1-2.

HAEMONCHUS CONTORTUS (RUDOLPHI, 1802) COBB, 1898 FROM AN INDIAN ELEPHANT IN MYSORE

AN Indian elephant which was captured on 9-3-1969 died at Kalhalla, S. Coorg, Mysore State, on 31-12-1969. The elephant had been weak from the time of its capture and there were swellings on the ventral aspect of neck and abdomen which had disappeared after treatment. The postmortem was conducted on 1-1-1970 and numerous nematodes and bots were collected from the intestine and stomach respectively.

In India the parasites of the elephant have been recorded and described by Lane (1914, 1921), Ware (1924), Bhale Rao (1935), Ramanujachari and Alwar (1954) and Mahl and Singh (1958). Immature specimens of a species of *Choniangium* were recorded by Ware (1924), from nodules in the wall of large intestine of an elephant at Coorg, Mysore State, whose specific identity was not established.

In the present study the following five species were identified:

1. *Haemonchus contortus* (Rudolphi, 1802) Cobb, 1898.
2. *Murshidia indica* Ware, 1924
3. *Quilonia travancra* Lane, 1914
4. *Equinubria sipunculiformis* (Baird, 1859) Lane, 1914.
5. *Choniangium magnostomum* Westhuysen, 1938.

The bots were identified as *Cobboldia elephantis* (Cobbold, 1866).

The identification was based on the descriptions given by Westhuysen (1938), Skrjabin (1952), Soulsby (1968), and Sen and Fletcher (1962).

This is the first record of *H. contortus* among the parasites of the elephant so far described and no other Trichostrongylid worm has been recorded in this animal.

The authors are grateful to Dr. K. S. Hegde, Professor of Parasitology, Veterinary College, for his helpful guidance, to Dr. N. S. Krishna Rao for his help in writing this note and to Dr. R. D. Nanjiah, Director of Instruction,

Veterinary College, University of Agricultural Sciences, for the encouragement given.

S. Abdul Rahman.*
K. R. Sukumara Pillay.**
B. V. Prema.‡
M. Narayanaswamy.‡

February 27, 1970.

---

* Department of Parasitology, Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-24 (Mysore State).

** Veterinary Assistant Surgeon, Pollibetta, S. Coorg (Mysore State).

‡ Mysore Serum Institute, Hebbal, Bangalore-24.

1. Bhale Rao, G. D., *Ind. J. Vet. Sci. and A.H.*, March 1935, **5**, Part I.
2. Lane, C., *Ind. J. Med. Res.*, 1914, **2**, 380.
3. —, *Ibid.*, 1921, **9**, 163.
4. Malik, B. S. and Singh, G., *Proc. Nat. Acad. Sci. (India)*, Allahabad, 1958, **28**, Sec. B, Part II, 191.
5. Ramanujachari, G. and Alwar, V. S., *Ind. Vet. J.*, 1954, **31**, 37.
6. Sen, S. K. and Fletcher, T. B., *Veterinary Entomology and Acarology for India*, Indian Council of Agricultural Research, New Delhi, 1962.
7. Skrjabin, K. I., *Key to Parasitic Nematodes* (English translation by Israel Program for Scientific Translation, Jerusalem, 1961), Vol. 3, 1952.
8. Soulsby, E. J. L., *Helminths, Arthropods and Protozoa of Domesticated Animals*, Bailliere, Tindall and Cassell, London, 1968.
9. Ware, F., *J. Comp. Path. Therap.*, 1924, **37**, 278.
10. Westhuysen, O. P. V., *Onderst. J. Vet. Sci. and A.H.*, 1938, **10**, 49.

REVIEWS AND NOTICES OF BOOKS

British Medical Bulletin : Immunization against Infectious Diseases. Scientific Editor D. G. Evans. (Published by the Medical Department, The British Council, 97 and 99, Park Street, London, W. 1), 1969. Pp. 100. Price £2.

This Bulletin under review contains the following articles: Introduction, by D. G. Evans; World Problems in Viral Vaccines, by W. Chas. Cockburn; The Search for Protective Antigens, by Harry Smith; Immunization Against Smallpox, by C. Kaplan; Rabies Vaccines, by G. S. Turner; Arbovirus Vaccines, by C. E. Gordon Smith; Immunization Against Poliomyelitis, by A. J. Beale; Measles Vaccines, by J. A. Dudgeon; Rubella Vaccines, by J. A. Dugein; Vaccination Against Respiratory Viruses, by D. A. J. Tyrrell; Rickettsial Vaccines, by J. H. S. Gear; Diphtheria and Tetanus Toxoids, by J. W. G. Smith; B.C.G. Vaccination in Mycobacterial Infections, by R. J. W. Rees; Pertussis, TAB and Cholera Vaccines, by A. F. B. Standfast; Immunization Against Protozoal Diseases, by R. A. Neal, P. C. C. Garnham and S. Cohen; Human Immunoglobulin in Prophylaxis, by T. M. Pollock; and Safety of Vaccines, by F. T. Perkins.

C. V. R.

Principles of Dispersal in Higher Plants. By L. van der Pijl. (Springer-Verlag, Berlin, Heidelberg and New York), 1969. Pp. vii + 154. Price DM 36; U.S. $9.00.

The work offered here is a companion volume to the work by K. Faegri and L. van der Pijl *Principles of Pollination Ecology*, which deals with the preceding phase of reproduction in plants.

In the present work too, the emphasis is on principles and ecology. It is neither an enumeration of mechanisms, nor a compilation of cases. Ridley's monumental work, *The Dispersal of Plants Throughout the World*, already compresses 700 large pages of small print, and research has proceeded since then. Though this work is more than just a compilation and contains much insight and thoughts on principles in addition to reviews, its completeness hinders its use as a text-book. As a reference work, it is unsurpassed and the writer made frequent use of it.

The contents of this book are: I. Introduction; II. General Terminology; III. The Units of Dispersal; IV. The Relation between Flowers, Seeds and Fruits; V. Ecological Dispersal Classes, Established on the Basis of the Dispersing Agents; VI. Combination, Limitation and Cooperation; VII. Establishment; VIII. The Evolution of Dispersal Organs; IX. Ecological Developments in Leguminous Fruits; and X. Man and His Plants.

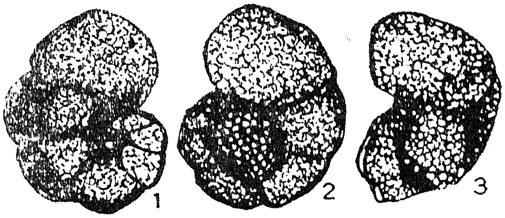
C. V. R.

Ornamental Bulbous Plants. By S. L. Jindal. (Indian Council of Agricultural Research, New Delhi), 1968. Pp. xvii + 190. Price Rs. 19·75.

Bulbous plants constitute one of the most important groups of the floral wealth of the

Genus *Praeindicola* Singh and Kalia, n. gen.

(Figs. 1-3)



FIGS. 1-3. Fig. 1. Dorsal view, × 120. Fig. 2. Ventral view, × 120. Fig. 3. Lateral view, × 120.

Generic diagnosis.—Test free, trochospiral; periphery broadly truncated, keeled; chambers globular to subglobular, few, enlarging rapidly; umbilicus filled with undifferentiated filamentous mass; primary aperture interiomarginal multiple; wall calcareous perforate; radial bilamellar in microstructure; surface structure distinctly favose.

Comparison and Remarks.—The present genus differs from all other genera described under the Globigerinacea in possessing the primary interiomarginal multiple aperture and the infilling of the umbilical space, except with the genus *Indicola* Singh and Kalia, 1970, with which it differs in certain details of the test morphology. *Praeindicola* n. gen. has a close superficial resemblance with the eponidid genera *Neocribrella* Cushman, 1928, *Cincoriola* Haque, 1958, and *Hofkerina* Chapmann and Parr 1931, but differs from them particularly in possessing multiple primary aperture interiomarginal in position. *Cincoriola* Haque described from the Ranikot (Palaeocene) of West Pakistan seems to be the nearest comparable genus, but in the absence of any information about the detailed microstructure of its wall and the nature of the umbilical infilling, an attempt to compare with it is rather difficult. However, there is every possibility that after a detailed restudy, the genus *Cincoriola* Haque may prove to be the earliest members of the family Indicolidæ.

Type locality.—6 kilometers west of Shri Kolayatji, near Fuller's earth quarry, Bikaner, Rajasthan, India.

Type horizon.—Ostracod Zone, Kolayatji stage, Laki series (Ypresian).

Department of Geology, S. N. Singh.
University of Lucknow,
Lucknow-7.
and
Geology Department, Prabha Kalia.
Delhi University, Delhi-7, May 26, 1970.

---

1. Singh, S. N. and Kalia, Prabha, "Micropaleontology," *Amer. Mus. Nat. Hist.* New York, U.S.A., Jan., 1970, **16** (1), 76, Pls. 1-2.

HAEMONCHUS CONTORTUS (RUDOLPHI, 1802) COBB, 1898 FROM AN INDIAN ELEPHANT IN MYSORE

An Indian elephant which was captured on 9-3-1969 died at Kalhalla, S. Coorg, Mysore State, on 31-12-1969. The elephant had been weak from the time of its capture and there were swellings on the ventral aspect of neck and abdomen which had disappeared after treatment. The postmortem was conducted on 1-1-1970 and numerous nematodes and bots were collected from the intestine and stomach respectively.

In India the parasites of the elephant have been recorded and described by Lane (1914, 1921), Ware (1924), Bhale Rao (1935), Ramanujachari and Alwar (1954) and Malik and Singh (1958). Immature specimens of a species of *Choniangium* were recorded by Ware (1924), from nodules in the wall of large intestine of an elephant at Coorg, Mysore State, whose specific identity was not established.

In the present study the following five species were identified:

1. *Haemonchus contortus* (Rudolphi, 1802) Cobb, 1898.
2. *Murshidia indica* Ware, 1924
3. *Quilonia travancra* Lane, 1914.
4. *Equinubria sipunculiformis* (Baird, 1859) Lane, 1914.
5. *Choniangium magnostomum* Westhuysen, 1938.

The bots were identified as *Cobboldia elephantis* (Cobbold, 1866).

The identification was based on the descriptions given by Westhuysen (1938), Skrjabin (1952), Soulsby (1968), and Sen and Fletcher (1962).

This is the first record of *H. contortus* among the parasites of the elephant so far described and no other Trichostrongylid worm has been recorded in this animal.

The authors are grateful to Dr. K. S. Hegde, Professor of Parasitology, Veterinary College, for his helpful guidance, to Dr. N. S. Krishna Rao for his help in writing this note and to Dr. R. D. Nanjiah, Director of Instruction,

Veterinary College, University of Agricultural Sciences, for the encouragement given.

S. Abdul Rahman.
K. R. Sukumara Pillay.**
B. V. Prema.‡
M. Narayanaswamy.‡

February 27, 1970.

---

* Department of Parasitology, Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-24 (Mysore State).

** Veterinary Assistant Surgeon, Pollibetta, S. Coorg (Mysore State).

‡ Mysore Serum Institute, Hebbal, Bangalore-24.

1. Bhale Rao, G. B., *Ind. J. Vet. Sci. and A.H.*, March 1935, **5**, Part I.
2. Lane, C., *Ind. J. Med. Res.*, 1914, **2**, 380.
3. —, *Ibid.*, 1921, **9**, 163.
4. Malik, B. S. and Singh, G., *Proc. Nat. Acad. Sci. (India)*, Allahabad, 1958, **28**, Sec. B, Part II, 191.
5. Ramanujachari, G. and Alwar, V. S., *Ind. Vet. J.*, 1954, **31**, **37**.
6. Sen, S. K. and Fletcher, T. B., *Veterinary Entomology and Acarology for India*, Indian Council of Agricultural Research, New Delhi, 1962.
7. Skrjabin, K. I., *Key to Parasitic Nematodes* (English translation by Israel Program for Scientific Translation, Jerusalem, 1961), Vol. 3, 1952.
8. Soulsby, E. J. L., *Helminths, Arthropods and Protozoa of Domesticated Animals*, Bailliere, Tindall and Cassell, London, 1968.
9. Ware, F., *J. Comp. Path. Therap.*, 1924, **37**, **278**.
10. Westhuysen, O. P. V., *Onderst. J. Vet. Sci. and A.H.*, 1938, **10**, **49**.

REVIEWS AND NOTICES OF BOOKS

British Medical Bulletin. Immunization against Infectious Diseases. Scientific Editor D. G. Evans. (Published by the Medical Department, The British Council, 97 and 99, Park Street, London, W. 1.), 1969. Pp. 100. Price [illegible].

This Bulletin under review contains the following articles: Introduction, by D. G. Evans; World Progress in Viral Vaccines, by W. Chas. Cockburn; The Search for Protective Antigens, by Harry Smith; Immunization Against Smallpox, by C. Kaplan; Rabies Vaccines, by G. S. Turner; Arbovirus Vaccines, by [illegible]; Immunization Against Poliomyelitis, by A. J. Beale; Measles [illegible], Rubella Vaccines, by [illegible]; Vaccination Against Respiratory Viruses, by D. A. J. Tyrrell; Rickettsial Vaccines, by J. H. [illegible]; Diphtheria and Tetanus Toxoids, by J. W. G. Smith; BCG Vaccination in Mycobacterial Infections, by R. J. W. Rees; Pertussis, TAB and Cholera Vaccines, by A. F. B. Standfast; Immunization Against Protozoal Diseases, by R. A. Neal, P. C. C. Garnham and S. Cohen; Human Immunoglobulin in Prophylaxis, by T. M. Pollock; and Safety of Vaccines, by F. T. Perkins.

C. V. R.

Principles of Dispersal in Higher Plants. By L. van der Pijl. (Springer-Verlag, Berlin, Heidelberg and New York), 1969. Pp. vii + 154. Price DM 36; U.S. $ 9.90.

The work offered here is a companion volume to the work by K. Faegri and L. van der Pijl *Principles of Pollination Ecology*, which deals with the preceding phase of reproduction in plants.

In the present work too, the emphasis is on principles and ecology. It is neither an enumeration of mechanisms, nor a compilation of cases. Ridley's monumental work, *The Dispersal of Plants Throughout the World*, already comprises 700 large pages of small print, and research has proceeded since then. Though this work is more than just a compilation and contains much insight and thoughts on principles in addition to reviews, its completeness hinders its use as a text-book. As a reference work, it is unsurpassed and the writer made frequent use of it.

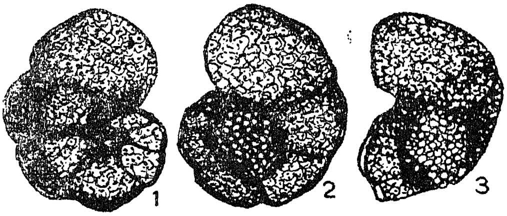
The contents of this book are: I. Introduction; II. General Terminology; III. The Units of Dispersal; IV. The Relation between Flowers, Seeds and Fruits; V. Ecological Dispersal Classes, Established on the Basis of the Dispersing Agent; VI. Combination, Limitation and Cooperation; VII. Establishment; VIII. The Evolution of Dispersal Organs; IX. Ecological Developments in Leguminous Fruits; and X. Man and His Plants.

C. V. R.

Ornamental Bulbous Plants. By S. L. Jindal. (Indian Council of Agricultural Research, New Delhi), 1968. Pp. xvii + 190. Price Rs. 19·75.

Bulbous plants constitute one of the most important groups of the floral wealth of the

Genus *Praeindicola* Singh and Kalia, n. gen.
(FIGS. 1-3)



FIGS. 1-3. Fig. 1. Dorsal view, × 120. Fig. 2. Ventral view, × 120. Fig. 3. Lateral view, × 120.

Generic diagnosis.—Test free, trochospiral; periphery broadly truncated, keeled; chambers globular to subglobular, few, enlarging rapidly; umbilicus filled with undifferentiated filamentous mass; primary aperture interiomarginal multiple; wall calcareous, perforate; radial bilamellar in microstructure; surface structure distinctly favose.

Comparison and Remarks.—The present genus differs from all other genera described under the Globigerinacea in possessing the primary interiomarginal multiple aperture and the infilling of the umbilical space, except with the genus *Indicola* Singh and Kalia, 1970, with which it differs in certain details of the test morphology. .*Praeindicola* n. gen. has a close superficial resemblance with the eponidid genera *Neocribrella* Cushman, 1928, *Cincoriola* Haque, 1958, and *Hofkerina* Chapmann and Parr 1931, but differs from them particularly in possessing multiple primary aperture interiomarginal in position. *Cincoriola* Haque described from the Ranikot (Palæocene) of West Pakistan seems to be the nearest comparable genus, but in the absence of any information about the detailed microstructure of its wall and the nature of the umbilical infilling, an attempt to compare with it is rather difficult. However, there is every possibility that after a detailed restudy, the genus *Cincoriola* Haque may prove to be the earliest members of the family Indicolidæ.

Type locality.—6 kilometers west of Shri Kolayatji, near Fuller's earth quarry, Bikaner, Rajasthan, India.

Type horizon.—Ostracod Zone, Kolayatji stage, Laki series (Ypresian).

Department of Geology, S. N. SINGH.
University of Lucknow,
Lucknow-7.
and
Geology Department, PRABHA KALIA.
Delhi University, Delhi-7, May 26, 1970.

---

1. Singh, S. N. and Kalia, Prabha, "Micropaleontology," *Amer. Mus. Nat. Hist.*, New York, U.S.A., Jan., 1970, **16** (1), 76, Pls. 1-2.

HAEMONCHUS CONTORTUS (RUDOLPHI, 1802) COBB, 1898 FROM AN INDIAN ELEPHANT IN MYSORE

AN Indian elephant which was captured on 9-3-1969 died at Kalhalla, S. Coorg, Mysore State, on 31-12-1969. The elephant had been weak from the time of its capture and there were swellings on the ventral aspect of neck and abdomen which had disappeared after treatment. The postmortem was conducted on 1-1-1970 and numerous nematodes and bots were collected from the intestine and stomach respectively.

In India the parasites of the elephant have been recorded and described by Lane (1914, 1921), Ware (1924), Bhale Rao (1935), Ramanujachari and Alwar (1954) and Malik and Singh (1958). Immature specimens of a species of *Choniangium* were recorded by Ware (1924), from nodules in the wall of large intestine of an elephant at Coorg, Mysore State, whose specific identity was not established.

In the present study the following five species were identified :—

1. *Hæmonchus contortus* (Rudolphi, 1802) Cobb, 1898.
2. *Murshidia indica* Ware, 1924.
3. *Quilonia travancra* Lane, 1914.
4. *Equinubria sipunculiformis* (Baird, 1859) Lane, 1914.
5. *Choniangium magnostomum* Westhuysen, 1938.

The bots were identified as *Cobboldia elephantis* (Cobbold, 1866).

The identification was based on the descriptions given by Westhuysen (1938), Skrjabin (1952), Soulsby (1968), and Sen and Fletcher (1962).

This is the first record of *H. contortus* among the parasites of the elephant so far described and no other Trichostrongylid worm has been recorded in this animal.

The authors are grateful to Dr. K. S. Hegde, Professor of Parasitology, Veterinary College, for his helpful guidance, to Dr. N. S. Krishna Rao for his help in writing this note and to Dr. R. D. Nanjiah, Director of Instruction,

Veterinary College, University of Agricultural Sciences, for the encouragement given.

S. ABDUL RAHMAN.
K. R. SUKUMARA PILLAY.
B. V. [illegible]
M. NARAYANASWAMY †

February 27, 1970.

---

* Department of Parasitology, Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-24 (Mysore State).

** Veterinary Assistant Surgeon, Pollibetta, S. Coorg (Mysore State).

† Mysore Serum Institute, Hebbal, Bangalore-24.

1. Bhalerao, G. D., *Ind. J. Vet. Sci. and A.H.*, March 1935, **5**, Part I.
2. Lane, C., *Ind. J. Med. Res.*, 1914, **2**, 380.
3. —, *Ibid.*, 1921, **9**, 163.
4. Malik, B. S. and Singh, G., *Proc. Nat. Acad. Sci. (India)*, Allahabad, 1958, **28**, Sec. B, Part II, 191.
5. Ramanujachari, G. and Alwar, V. S., *Ind. Vet. J.*, 1954, **31**, **37**.
6. Sen, S. K. and Fletcher, T. B., *Veterinary Entomology and Acarology for India*, Indian Council of Agricultural Research, New Delhi, 1962.
7. Skrjabin, K. I., *Key to Parasitic Nematodes* (English translation by Israel Program for Scientific Translation, Jerusalem, 1961), Vol. 3, 1952.
8. Soulsby, E. J. L., *Helminths, Arthropods and Protozoa of Domesticated Animals*, Bailliere, Tindall and Cassell, London, 1968.
9. Ware, F., *J. Comp. Path. Therap.*, 1924, **37**, 278.
10. Westhuysen, O. P. V., *Onderst. J. Vet. Sci. and A.H.*, 1938, **10**, 49.

REVIEWS AND NOTICES OF BOOKS

British Medical Bulletin: Immunization against Infectious Diseases. Scientific Editor D. G. Evans. (Published by The Medical Department, The British Council, 97 and 99, Park Street, London W. 1), 1969. Pp. 100. Price £ 2.

The Bulletin under review contains the following articles: Introduction, by D. G. Evans; World Progress in Viral Vaccines, by W. Chas. Cockburn; The Search for Protective Antigens, by [illegible]; Immunization Against [illegible], by [illegible] Kaplan; Rabies Vaccine [illegible]; Arbovirus [illegible]; Immunization Against Poliomyelitis, by A. J. Beale; [illegible] Rubella Vaccine [illegible]; Vaccination Against Respiratory Viruses, by [illegible] Tyrrell; Rickettsial Vaccines, by [illegible]; Diphtheria [illegible] by [illegible] G. Smith; BCG Vaccination in Mycobacterial Infections, by R. J. W. Rees; Pertussis, TAB and Cholera Vaccines, by A. F. B. Standfast; Immunization Against Protozoal Diseases, by R. A. Neal, P. C. C. Garnham and S. Cohen; Human Immunoglobulin in Prophylaxis, by T. M. Pollock; and Safety of Vaccines, by F. T. Perkins.

C. V. R.

Principles of Dispersal in Higher Plants. By L. van der Pijl. (Springer Verlag, Berlin, Heidelberg and New York), 1969. Pp. vii + 154. Price DM 36; US $ 9.00.

The work offered here is a companion volume to the work by K. Faegri and L. van der Pijl *Principles of Pollination Ecology*, which deals with the preceding phase of reproduction in plants.

In the present work too, the emphasis is on principles and ecology. It is neither an enumeration of mechanisms, nor a compilation of cases. Ridley's monumental work, *The Dispersal of Plants Throughout the World*, already comprises 700 large pages of small print, and research has proceeded since then. Though this work is more than just a compilation and contains much insight and thoughts on principles in addition to reviews, its completeness hinders its use as a text-book. As a reference work, it is unsurpassed and the writer made frequent use of it.

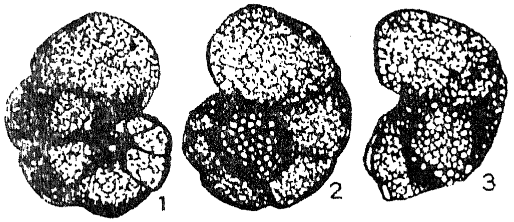
The contents of this book are: I. Introduction; II. General Terminology; III. The Units of Dispersal; IV. The Relation between Flowers, Seeds and Fruits; V. Ecological Dispersal Classes, Established on the Basis of the Dispersing Agents; VI. Combination, Limitation and Cooperation; VII. Establishment; VIII. The Evolution of Dispersal Organs; IX. Ecological Developments in Leguminous Fruits; and X. Man and His Plants.

C. V. R.

Ornamental Bulbous Plants. By S. L. Jindal. (Indian Council of Agricultural Research, New Delhi), 1968. Pp. xvii + 190. Price Rs. 19·75.

Bulbous plants constitute one of the most important groups of the floral wealth of the

Genus *Praeindicola* Singh and Kalia, n. gen.
(FIGS. 1-3)



FIGS. 1-3. Fig. 1. Dorsal view, × 120. Fig. 2. Ventral view, × 120. Fig. 3. Lateral view, × 120.

Generic diagnosis. Test free, trochospiral; periphery broadly truncated, keeled; chambers globular to subglobular, few, enlarging rapidly; umbilicus filled with undifferentiated filamentous mass; primary aperture interiomarginal multiple; wall calcareous perforate; radial bilamellar in microstructure; surface structure distinctly favose.

Comparison and Remarks. The present genus differs from all other genera described under the Globigerinacea in possessing the primary interiomarginal multiple aperture and the infilling of the umbilical space, except with the genus *Indicola* Singh and Kalia, 1970, with which it differs in certain details of the test morphology. *Praeindicola* n. gen. has a close superficial resemblance with the eponidid genera *Neocribrella* Cushman, 1928, *Cincoriola* Haque, 1958, and *Hofkerina* Chapmann and Parr 1931, but differs from them particularly in possessing multiple primary aperture interiomarginal in position. *Cincoriola* Haque described from the Ranikot (Palaeocene) of West Pakistan seems to be the nearest comparable genus, but in the absence of any information about the detailed microstructure of its wall and the nature of the umbilical infilling, an attempt to compare with it is rather difficult. However, there is every possibility that after a detailed restudy, the genus *Cincoriola* Haque may prove to be the earliest members of the family Indicolidae.

Type locality.—6 kilometers west of Shri Kolayatji, near Fuller's earth quarry, Bikaner, Rajasthan, India.

Type horizon.—Ostracod Zone, Kolayatji stage, Laki series (Ypresian).

Department of Geology, S. N. SINGH.
University of Lucknow,
Lucknow-7.
and
Geology Department, PRABHA KALIA.
Delhi University, Delhi-7, *May* 26, 1970.

---

1. Singh, S. N. and Kalia, Prabha, "Micropaleontology," *Amer. Mus. Nat. Hist.* New York, U.S.A., Jan., 1970, **16** (1), 76, Pls. 1 2.

HAEMONCHUS CONTORTUS (RUDOLPHI, 1802) COBB, 1898 FROM AN INDIAN ELEPHANT IN MYSORE

AN Indian elephant which was captured on 9 3 1969 died at Kalhalla, S. Coorg, Mysore State, on 31 12 1969. The elephant had been weak from the time of its capture and there were swellings on the ventral aspect of neck and abdomen which had disappeared after treatment. The postmortem was conducted on 1 1 1970 and numerous nematodes and bots were collected from the intestine and stomach respectively.

In India the parasites of the elephant have been recorded and described by Lane (1914, 1921), Ware (1924), Bhale Rao (1935), Ramanujachari and Alwar (1954) and Malik and Singh (1958). Immature specimens of a species of *Choniangium* were recorded by Ware (1924), from nodules in the wall of large intestine of an elephant at Coorg, Mysore State, whose specific identity was not established.

In the present study the following five species were identified:

1. *Haemonchus contortus* (Rudolphi, 1802) Cobb, 1898.
2. *Murshidia indica* Ware, 1924.
3. *Quilonia travancra* Lane, 1914.
4. *Equinubria sipunculiformis* (Baird, 1859) Lane, 1914.
5. *Choniangium magnostomum* Westhuysen, 1938.

The bots were identified as *Cobboldia elephantis* (Cobbold, 1866).

The identification was based on the descriptions given by Westhuysen (1938), Skrjabin (1952), Soulsby (1968), and Sen and Fletcher (1962).

This is the first record of *H. contortus* among the parasites of the elephant so far described and no other Trichostrongylid worm has been recorded in this animal.

The authors are grateful to Dr. K. S. Hegde, Professor of Parasitology, Veterinary College, for his helpful guidance, to Dr. N. S. Krishna Rao for his help in writing this note and to Dr. R. D. Nanjiah, Director of Instruction,

Veterinary College, University of Agricultural Sciences, for the encouragement given.

S. Abdul Rahman.*
K. R. Sukumara Pillay.**
B. V. Prema.†
M. Narayanaswamy.†

February 27, 1970.

---

* Department of Parasitology, Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-24 (Mysore State).

** Veterinary Assistant Surgeon, Pollibetta, S. Coorg (Mysore State).

† Mysore Serum Institute, Hebbal, Bangalore-24.

1. Bhale Rao, G. D., *Ind. J. Vet. Sci. and A.H.*, March 1935, **5**, Part I.
2. Lane, C., *Ind. J. Med. Res.*, 1914, **2**, 380.
3. —, *Ibid.*, 1921, **9**, 163.
4. Malik, B. S. and Singh, G., *Proc. Nat. Acad. Sci. (India)*, Allahabad, 1958, **28**, Sec. B, Part II, 191.
5. Ramanujachari, G. and Alwar, V. S., *Ind. Vet. J.*, 1954, **31**, 37.
6. Sen, S. K. and Fletcher, T. B., *Veterinary Entomology and Acarology for India*, Indian Council of Agricultural Research, New Delhi, 1962.
7. Skrjabin, K. I., *Key to Parasitic Nematodes* (English translation by Israel Program for Scientific Translation, Jerusalem, 1961), Vol. 3, 1952.
8. Soulsby, E. J. L., *Helminths, Arthropods and Protozoa of Domesticated Animals*, Bailliere, Tindall and Cassell, London, 1968.
9. Ware, F., *J. Comp. Path. Therap.*, 1924, **37**, 278.
10. Westhuysen, O. P. V., *Onderst. J. Vet. Sci. and A.H.*, 1938, **10**, 49.

REVIEWS AND NOTICES OF BOOKS

British Medical Bulletin: Immunization against Infectious Diseases. Scientific Editor D. G. Evans. (Published by the Medical Department, The British Council, 97 and 99, Park Street, London, W. 1), 1969. Pp. 100. Price £ 2.

The Bulletin under review contains the following articles: Introduction, by D. G. Evans; World Problems in Viral Vaccines, by W. Charles Cockburn; The Search for Protective Antigens, by Harry Smith; Immunization Against Smallpox, by C. Kaplan; Rabies Vaccines, by G. S. Turner; Arbovirus Vaccines, by C. E. Gordon Smith; Immunization Against Poliomyelitis, by A. J. Beale; Measles [illegible] Dudgeon; Rubella Vaccines, by J. S. [illegible]; Vaccination Against Respiratory Viruses, by D. A. J. Tyrrell; Rickettsial Vaccines, by J. H. S. Gear; Diphtheria and Tetanus Toxoids, by J. W. G. Smith; BCG Vaccination in Mycobacterial Infections, by R. J. W. Rees; Pertussis, TAB and Cholera Vaccines, by A. F. B. Standfast; Immunization Against Protozoal Diseases, by R. A. Neal, P. C. C. Garnham and S. Cohen; Human Immunoglobulin in Prophylaxis, by T. M. Pollock; and Safety of Vaccines, by F. T. Perkins.

C. V. R.

Principles of Dispersal in Higher Plants. By L. van der Pijl. (Springer-Verlag, Berlin, Heidelberg and New York), 1969. Pp. vii + 154. Price DM 36; U.S. $ 9.00.

The work offered here is a companion volume to the work by K. Faegri and L. van der Pijl *Principles of Pollination Ecology*, which deals with the preceding phase of reproduction in plants.

In the present work too, the emphasis is on principles and ecology. It is neither an enumeration of mechanisms, nor a compilation of cases. Ridley's monumental work, *The Dispersal of Plants Throughout the World*, already compresses 700 large pages of small print, and research has proceeded since then. Though this work is more than just a compilation and contains much insight and thoughts on principles in addition to reviews, its completeness hinders its use as a text-book. As a reference work, it is unsurpassed and the writer made frequent use of it.

The contents of this book are: I. Introduction; II. General Terminology; III. The Units of Dispersal; IV. The Relation between Flowers, Seeds and Fruits; V. Ecological Dispersal Classes, Established on the Basis of the Dispersing Agents; VI. Combination, Limitation and Cooperation; VII. Establishment; VIII. The Evolution of Dispersal Organs; IX. Ecological Developments in Leguminous Fruits; and X. Man and His Plants.

C. V. R.

Ornamental Bulbous Plants. By S. L. Jindal. (Indian Council of Agricultural Research, New Delhi), 1968. Pp. xvii + 190. Price Rs. 19·75.

Bulbous plants constitute one of the most important groups of the floral wealth of the

country. Beauty, fragrance and colour of their bloom, the superb excellence of their flowers for interior decorations, their symbolic values and medicinal aspects have been responsible for endearing their cultivation to the garden lover.

The *Ornamental Bulbous Plants* gives in detail the description of bulbous plants which can be grown under Indian conditions, so that garden enthusiast can fully exploit their beauty.

The author of this publication, who has the practical experience of growing many of the plants described in this book, has brought together information on various aspects of growth and culture of these plants. The book has been written in a simple language to be of help to amateur gardeners, and is profusely illustrated. C. V. R.

History of Indian Astronomy—*Bharatiya Jyotish Sastra*. By Sankar Balakrishna Dikshit, Part I. English translation, by R. V. Vaidya. (The Manager of Publications, Civil Lines, Delhi-6), 1969. Pp. xxxiv + 147. Price Rs. 12·50; 29 *sh.* 2 *d.* or $4.50.

Bharatiya Jyotish Sastra, originally published in 1896 in the Marathi language, is the outcome of a deep and critical study made by the Vedantic and Sanskrit scholar Sankar Balakrishna Dikshit to trace the history and development of Indian astronomy in ancient times.

We get evidence of astronomical observations in India extending back to a few millennia B.C. in the verses of Rig-Veda and the Yajur-Veda. As early as 1300 B.C. the Hindus developed a luni-solar calendar known as *Vedanga Jyotish Calendar* which was in vogue upto the third century A.D. The Siddhantic system of astronomy came later and its development continued up to the 12th century A.D.

Authentic information as to the history and growth of Indian astronomy has to be culled out from references scattered in the verses of the Vedas and ancient Sanskrit scriptures and texts still extant. Even then such references are couched in strange language, allegories and mythic stories, and they need careful study and commentation. Many scholars, Western as well as Oriental, have made great contributions in this direction in the last century. Shri Sankar Balakrishna Dikshit's treatise is perhaps the only book recording the history of Indian astronomy from the ancient to the modern times, and it deserves to be more widely known to Indologists, foreign and Indian.

Thus the undertaking by the India Meteorological Department to bring out an English translation of this treatise will be welcome not only to researchers in the history of astronomy but also to the non-Marathi-knowing public of India interested in ancient Hindu astronomy.

The volume under review is Part I of the treatise and it traces the history of Indian astronomy in the Vedic and Vedanga periods from the ancient times up to 1000 B.C. In the text Vedic *mantras* and Sanskrit verses have been frequently quoted and their gists are given along with the author's critical comments. The other two parts comprising the Siddhantic period and the Modern period are expected to be brought out early. A. S. G.

Books Received

Elementary Functions—An Introduction. By J. T. Mohat. (Addison-Wesley Pub. Co., London W. 1, England), 1970. Pp. viii + 312. Price 65 *sh.*

Elements of Quantum Theory. By F. J. Bockhoff. (Addison-Wesley Pub. Co., London W. 1, England), 1970. Pp. viii + 2; ix + 304. Price 43 *sh.*

Thiamin Diphosphate and Its Catalytic Functions. By L. O. Krampitz. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1970. Pp. ix + 65. Price $ 5.75.

Arithmetics for Metal Workers. By Engelbert Grytz. (Asia Publishing House, Calicut St., Ballard Estate, Bombay-1), 1969. Pp. 234.

National Biography Series—Jagadis Chandra Bose. By S. N. Basu. (The National Book Trust, A, 5, Green Park, New Delhi-16), 1970. Pp. v + 70. Price Rs. 2·00.

Carnegie Institution of Washington—Year-Book 68 (1968-69). (Carnegie Institution of Washington, Washington D.C.), 1970. Pp. xi + 716.

Aspects of Allergy and Applied Immunology (Vol. II). By R. Vishwanathan, R. K. Sanyal, S. Arora, G. Bazaz Malik and B. D. Miglani. (New Heights, M/1024, Daryaganj, Delhi-6), 1970. Pp. ii + 196. Price Rs. 30·00.

An Introduction to Ion Exchange. By Russell Paterson. (Hayden and Son Ltd., Spectrum House, Alderton Crescent, London N.W. 4), 1970. Pp. vi + 109. Price £ 2.10.0.

2145-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed
by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

MICROCLINIZATION OF PLAGIOCLASE BY SOLID-STATE REACTION

G. V. ANANTHA IYER, T. R. NARAYANAN KUTTY AND A. R. VASUDEVA MURTHY
Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore-12

THE natural conversion of albite ($NaAlSi_3O_8$) and microcline ($KAlSi_3O_8$) by the cation exchange reaction in the molten alkali halides has been reported by Wyart and Sabatier (1956) as well as by Orville (1967). The present series of experiments indicate that the reaction between albite and potassium halide takes place in the solid-state at a temperature of 550–600° C. Under the same set of conditions, conversion of disordered oligoclase to sanidine takes place. It is found that these solid-state reactions occur without any change in the order-disorder characteristics of the feldspars.

The powdered albite (*c*-200 to 250 mesh) is thoroughly mixed with dry potassium halide powder (chloride, bromide or iodide) in different ratios. The mixture is heated in a platinum crucible at 550° C. and maintained at this temperature for 72 hours. At the end of this interval of time, the mixture is cooled, washed with water on a sintered glass septum to dissolve all the alkali halides. The residue remaining on the septum is used for chemical analysis and infrared spectral studies. Experiments are carried out with different weight ratios of potassium halides (30, 5, 3 or 1 times the weight of albite). Reaction proceeds in all the cases at 550° C. and is complete in about 48–72 hours. Reaction is found to be quicker with potassium iodide.

The albite used in the present set of experiments is from the ore-pegmatite altered contact of the Nandydrug mine of Kolar Gold Fields. The chemical composition of this feldspar is SiO_2 68·8%, Al_2O_3 19·40% and Na_2O 10·76%. The calcium content in these samples is below detection. The sample of potassium feldspar obtained from the reaction has the composition SiO_2 64·7%, Al_2O_3 18·3% and K_2O 16·8% with minimum sodium content. It can be concluded that nearly complete replacement of sodium occurs during the reaction.

The infrared spectra of the albite, the converted material and a sample of potassium feldspar (microcline) are given in Fig. 1. The coincidence of spectra II and II are very evident. The spectrum shows that the microcline produced is highly ordered. As the degree of disordering increases, the bands in the 800–700 cm.$^{-1}$ become less sharp. It had been proved that infrared spectrum is a better tool in determining the order-disorder nature in feldspars (Hafner and Laves, 1962).

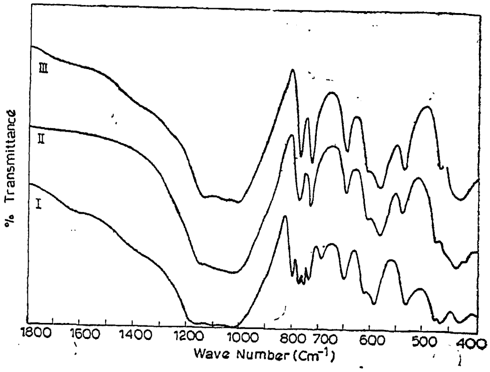


FIG. 1. Infrared spectrum. I—Albite. II—The product of reaction with KCl. III—Microcline.

The fact that the reaction occurs independent of the ratio of potassium halide to albite, indicates that the process is a solid-solid reaction. Alternatively, it can be treated as a simple exchange of cation in which the framework of linked SiO_4 and AlO_4 tetrahedra of the feldspar remain intact as in the case of zeolites. If it is a simple ion exchange of the zeolite type, the ratio of potassium halide to albite should affect the extent of reaction, the more the amount of potassium salt, the quicker and complete will be the exchange. The experimental data indicate no such characteristics and hence is a true solid-solid reaction.

The reaction is also done with oligoclase. The powdered oligoclase (from Halagur), when mixed with 30 times the weight of KCl and heated at 600° C. for 72 hours, gets converted into sanidine. The formation of sanidine is due to the fact that the oligoclase used is from the characteristic facies which is comparatively disordered (Fig. 2). The two series of reactions clearly indicate that the structural state of feldspars remains unaltered during the solid-state reaction.

These sets of reaction are of particular significance for the following reasons. The synthesis of potassium feldspar always results in the disordered monoclinic phase. The conversion of sanidine to microcline is never achieved under laboratory conditions. However, the ordered microcline is widely found in nature in the rocks of lower amphibolite facies. The origin of microclines in such cases can be explained as due to the solid-state conversion of plagioclase (albite rich) into microclines by potassium metasomatism. Petrographic works in the granitic rocks of South-East Precambrian of Mysore reveal that potassium feldspars were formed by the microclinization of plagioclases (Radhakrishna, 1956).

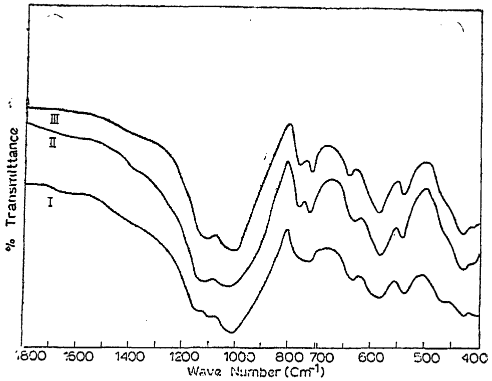


FIG. 2. Infrared spectrum of oligoclase. I—The reaction product by heating with KCl at 600° C. for 72 hrs. II and III—Sanidine.

The experiments, conducted under similar conditions for the reaction of sodium chloride with microcline, do not yield any albite.

---

1. Hafner and Laves, *Norsk Geologist Tidsskrift*, By$_2$ 2H, 1962.
2. Radhakrishna, B. P., *Mys. Geol. Asscn. Bull.*, **1956**, p. 3.
3. Philip, M. Orville, *American Mineralogist*, 1967, **52**, 55.
4. Wyart, J. and Sabatier, G., *Bull. Soc. Franc Mineral*, 1956, **79**, 414.

MAGNETIZATION OF METANORITE DYKE IN HIRAPUR, DHANBAD

JAGDEO SINGH AND M. KRISHNA RAO
Department of Applied Geophysics, Indian School of Mines, Dhanbad

METABASIC rocks of pre-Cambrian age occur intruding the Archean metamorphic rocks in and around Dhanbad (Bihar State). They include metanorite, metadolerite and epidiorite. The rocks were originally of doleritic composition but have been later subjected to metamorphism. They occur as irregular masses forming high and low hillocks and as broad dykes.

A magnetic study of a metabasic dyke in Dhaiya, Dhanbad, has been made by the authors.[1] The Hirapur and Dhaiya dykes are connected and they are about a mile apart.

The metanorite of Hirapur is composed of plagioclase (mostly labradorite) and pyroxene as essential, and olivine, biotite and magnetite as accessory minerals. The pyroxene is mainly pink hypersthene. Pyroxene is altered to fibrous green amphibole. Ophitic to subophitic texture is seen. Satyanarayana Murty and Agrawal[2] reported cloudiness of felspars in this metanorite and they attributed this to the effects of metamorphism.

The intensity and direction of natural remnant magnetization (N.R.M.) has been studied with Astatic magnetometer on oriented samples cut in the form of cylinders (discs). Volume susceptibility (k) has been determined with an A.C. bridge. The ratio J_n/J_i (Koenigsberger ratio, Q_n) is calculated. The results are shown in Table I. J_n and J_i stand for intensity of N.R.M. and induced magnetization (taking the total magnetic field at Dhanbad to be 0·45 oest.) and D and I for declination (East of north) and inclination (positive downwards) of N.R.M. respectively. The samples have been found to be magnetically stable.

The N.R.M. directions are shown in the stereographic projection (Fig. 1). All the samples have negative inclination. Based on the direction of horizontal magnetization, the samples are classified into two groups :

Group (1) : Normally magnetized in horizontal direction (samples H 10 to H 16).—The mean declination and inclination of these 7 samples are 30° and − 63°. This corresponds to normal magnetization in the southern hemisphere. The intensity of N.R.M., although quite low, is more or less consistent and varies from $0{\cdot}827 \times 10^{-3}$ to $0{\cdot}340 \times 10^{-3}$ c.g.s. units.

Group (2) : Reversely magnetized in the horizontal direction (samples H 1 to H 9, H 17 and H 18).—The mean declination and inclination of these 11 samples are 223° and − 59°. This corresponds to reversed magnetization in northern hemisphere. The intensity of N.R.M. is low and varies from $2{\cdot}515 \times 10^{-3}$ to $0{\cdot}214 \times 10^{-3}$ c.g.s. units.

The Koenigsberger ratio for all the 18 samples varies from 2·3 to 11·4 and the susceptibility, from 195 × 10^{-6} to 575 × 10^{-6} c.g.s. units.

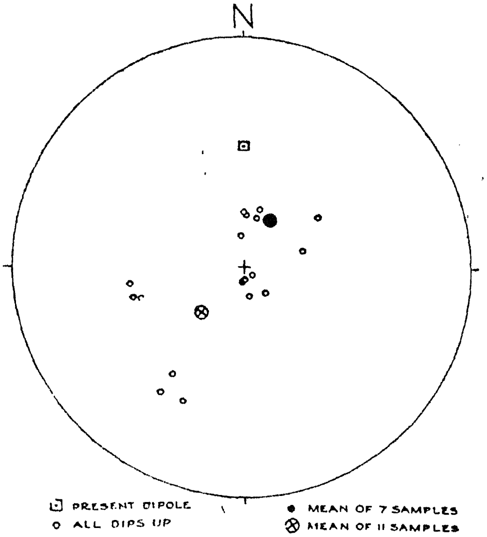


FIG. 1. Hirapur dyke stereographic projection.

TABLE I

Sl No.	Sample No.	D	I	Jn × 10^3 c.g.s. units	k × 10^6 c.g.s. units	J_i × 10^3 c.g.s. units	Q_n
1	H 1	183	−84	2·515	489	0·220	11·4
2	H 2	185	−83	2·373	489	0·220	10·8
3	H 3	170	−75	1·387	326	0·147	9·5
4	H 4	214	−23	0·621	407	0·183	3·4
5	H 5	205	−24	0·845	575	0·259	2·3
6	H 6	253	−40	0·580	489	0·220	3·8
7	H 7	214	−31	0·704	407	0·183	3·9
8	H 8	139	−73	0·235	244	0·101	2·3
9	H 9	130	−84	0·214	195	0·088	2·4
10	H 10	16	−65	0·414	244	0·101	4·0
11	H 11	72	−59	0·376	245	0·101	3·7
12	H 12	56	−46	0·346	163	0·073	5·4
13	H 13	354	−74	0·729	326	0·147	5·0
14	H 14	3	−64	0·705	243	0·101	7·0
15	H 15	16	−60	0·827	244	0·101	8·0
16	H 16	0	−63	0·752	309	0·139	5·5
17	H 17	261	−37	0·987	244	0·110	9·0
18	H 18	254	−37	0·940	246	0·111	8·6

The palæolatitudes (λ) for the place, as deduced from the two groups of magnetization, are shown in Table II.

TABLE II

Sl. No.	Direction of N.R.M. in hor. plane	No. of samples	D	I	a_{95}	K	λ⁻
1	Normal ..	7	30°	−63°	11°	33	44° S
2	Reversed ..	11	223°	−59°	19°	6	40° N

The magnetization of the two groups of samples is consistent with the position of India in the southern and northern hemispheres. The Deccan traps[3] and Rejmahal traps[4] and some dykes contemporaneous with these show a position in southern hemisphere, while Yeldurti hematites,[5] Visakhapatnam charnockites,[6] Malani rhyolites, Bijawar Traps and Mundwara Complex[7] and a dyke near Hyderabad[8] show a position in northern hemisphere.

It is interesting to note that both the groups are present in the same outcrop. An explanation is attempted here: The entire dyke has not been effected by metamorphism uniformly. Portions of the dyke not heated above the curie point of magnetic minerals, retained their original magnetism of northern hemisphere and those heated above the curie point acquired magnetism of southern hemisphere. It is presumed here that continental drift has taken place.

---

1. Krishna Rao, M. and Singh, Jagleo, *Curr. Sci.*, 1959, **28**, 157.
2. Satyanarayana Murty, K. V. V. and Agrawal, Y. K., *Sci. and Cult.*, 1960, **26**, 272.
3. Clegg, J. A., Deutsch, E. R. and Griffiths, D. H., *Phil. Mag.*, 1956, **1**, 419.
4. —, Radakrishnamurty, C. and Sahasrabudhe, P. W., *Nature*, 1958, **181**, 830.
5. Verma, R. K., Pullaiah, G. and Bhalla, M. S., *Geophy. Jnl.*, 1966, **11**, 5, 499.
6. Bhimasankaram, V. L. S., *Curr. Sci.*, 1964, **33** (15), 465.
7. Athavale, R. N., Radhakrishnamurty, C. and Sahasrabudhe, P. W., *Geophy. Jnl.*, 1963, **7** (3), 304.
8. Verma, R. K., Pullaiah, G. and Hasnain, I., *Bull. Natl. Geophy. Res. Inst.*, 1968, **6** (2), 79.

ESTABLISHMENT AND COLONIZATION BY A WILD POTATO SPECIES IN THE OLD WORLD—IN THE SIMLA HILLS, INDIA

N. M. NAYAR AND M. S. GOHAL
Central Potato Research Institute, Simla-1, H.P.

THE tuber-bearing *Solanums* (section *Tuberarium*, subgenus *Pachystemomum*, family Solanaceæ) are native to the Americas and occur throughout that continent except Guianas and Canada. They are present most abundantly in South Central Mexico and Peru-Bolivia-North-West Argentina. Though confined for the most part to mountains—upto 5,000 metres altitude, but mostly between 2,000–4,000 metres altitude—they are found in a great variety of habitats, from arid and semi-arid regions, to bleak alpine meadows, wet subtropical forests, and even in salty spray at sea-level.[1,2] The only report of section *Tuberarium* occurring in Old World is of some potato plants found growing in Basutoland, South Africa, at about 2,000 metres altitude.[3] They have been suggested as potatoes originally introduced in this region in 1830, or later escapes from their cultivation. They resemble a coarse cultivated plant.[1]

Plants of a tuberiferous *Solanum* species, *S. chacœnse* Bitt., have been found to grow naturally in Simla (latitude 31° 06′ N., longitude 77° 10′ E., elevation about 2,200 metres) for about the last 15 years. They first appeared on dumps where used soil and trash after harvesting pots in the glass house (wherein are planted experimental material and *Solanum* germplasm collections) of the Institute were being thrown. They began spreading steadily after about the first five years. They now occur in colonies, except inside and just outside the Botany laboratories of the Institute. Here, they are found in about a hectare of land, both singly and in clusters, all around the glass houses, in drainage channels, path sides, field borders, along hedges, waste lands and on dumps. The population has increased considerably during the last two years, and they have now begun to appear even as weeds in potato fields which have never been planted with any wild *Solanum* species.

Elsewhere, ten district populations have been located 200–2,000 metres away and consisting of 40–1,000 plants. The terrain of Simla is hilly, and the area is wooded, mostly with pure stands of *Cedrus*. All populations are at higher elevations than that of the Institute. The populations were observed regularly for their emergence, flowering and berry setting. About 15–50 plants each from six populations were planted singly in pots, and studied for their variations and breeding behaviour. The main inferences are given below.

This Institute has been maintaining since 1934, most of the tuber-bearing *Solanum* species. They have been introduced from Britain (Commonwealth Potato Collection and Prof. Hawkes' collection) and the USA (US Department of Agriculture). Most species have 2–6 accessions, but some like *S. chacœnse*, *S. demissum*, *S. acaule* and *S. phureja* have many more.

Obviously, the species first escaped on the rubbish dumps where soil and trash were being thrown after harvest from pots planted with experimental material including species. Since many accessions of this species have been available in the collection, tubers of more than one accession might have escaped and established themselves as plants thereafter. The species is self-incompatible, and hence berries would have been formed on these plants through outcrossing. These berries might then have been dispersed by birds. This is evident from the following: (1) Population size—New populations, when they make their first appearance, consist of colonies of 20 30 plants each. We have not so far observed plants singly anywhere except inside the Institute. (2) All the ten populations are located at higher elevations than that of the Institute, and rains could not therefore have dispersed them. (3) Grazing by cattle is limited in the area, and further, local cattle do not eat them.

The species, *S. chacœnse*, is self-incompatible and asexually propagated, but in its native habitats is generally seed-propagated.[2] But, in Simla hills its establishment, colonization and spread are being accomplished through a series of adaptive features brought about by shifts in breeding system. They are, firstly, as pointed out earlier, it disperses itself through berries carried by birds. Next, the colonies establish themselves asexually, as is evident from the following: (1) the three smallest populations do not flower, (2) the percentage of flowering plants and flower number per plant increase with population size, (3) the build-up rate of smaller populations is slow. It is well known that vegetative mode of reproduction is the safest and surest means of survival.

In the third stage, after colonies attain a certain size, their plants begin to flower, their incompatibility apparently breaks down, and they begin to produce berries, probably by selfing also. This is inferred from the following: (1) Populations having about 60 plants or more produce flowers, and the largest of populations (Institute) produce plenty of berries and seeds; (2) pollen was more than 75% stainable; (3) when selfed, about 40% of plants in largest populations produced berries and a single plant (one of 20 plants tested) of second largest population also produced a berry.

It is an established fact that self-compatibility gives more assured seed production than self-incompatibility. It is reasonable to assume that the largest population has now been going through this third stage, and the second largest population is just entering it. When once any population becomes well established, it is possible that it might revert back to its original self-incompatible nature, thus ensuring outbreeding. This maximizes the potentialities of sexual reproduction and is thus the most desirable breeding system. The Institute population seems to have established itself firmly in the area and has been spreading fast. They produce flowers and seeds in plenty, and since the last two seasons, have even begun to appear as weeds in potato fields.

The tuber-bearing *Solanum* species are a large group of over 150 species characterized by inter- and intraspecific variability. A number of them are weedy and ruderal in nature. *S. chacœnse* is a highly polymorphic weedy species and has the widest distribution in this group of species.[1,2]

It would be interesting to see why this species alone has been able to establish itself in this area, though the Institute has been growing most of the species, and perhaps growing and using even more widely, another weedy, widely occurring self-fertile species *S. demissum*. The material offers a good opportunity to observe the genetic mechanisms responsible for the establishment, colonization and spread of a self-incompatible species that is capable of both sexual and asexual reproduction in a new region half-way round the world. This is under way.

We thank Dr. Mukhtar Singh, Director, for his interest and Prof. J. G. Hawkes, University of Birmingham, U.K., for his valued comments and advice on an earlier draft of this paper.

---

1. Correll, D. S., *The Potato and Its Wild Relatives*, Texas Research Foundation, Renner, Texas, 1962.
2. Hawkes, J. G., *Scottish Plant Breed. Sta. Record*, 1963, p. 76.
3. Plank, J. E., van der, *J. Linn. Soc.*, 1949, **53**, 251.

ORIGIN OF "COMMON SUBSIDIARIES" OF STOMATA IN THE ANGIOSPERMS

N. RAMAYYA and T. RAJAGOPAL
Department of Botany, Osmania University, Hyderabad-7 (A.P.), India

OCCURRENCE of stomata separated from one another by several epidermal cells in leaves and other plant parts can be attributed to less frequent stomatal origin. But so often, stomata, irrespective of their structure and development, are spaced out by single epidermal cells or what could be called the "common subsidiaries". Presence of common subsidiaries, specially in high frequency, is significant in that it may not only affect the pattern of spacing of stomata but also their density; besides, it contradicts the notion that inhibitory organogenetic fields[1] operate during stomatogenesis. It was, therefore, considered that a study of the origin of common subsidiaries should yield some basic data on stomatal origin in space and time. As far as the authors are aware, there has been no work in the past on this aspect. Therefore, they present here results of their study on the origin of common subsidiaries in the leaves of three species, *Brassica oleracea* L., *Clematis gouriana* Roxb., and *Dioscorea bulbifera* L., where common subsidiaries are frequent. The investigation involved examination of epidermal peels from early stages of leaf primordia to those of mature blade. For convenience the abaxial leaf epidermis was only studied. Acetocarmine staining helped in following stomatogenesis in whole mounts of early stages of leaf development of which dermal peels are difficult to obtain. The mesogenous subsidiaries of the stomata are referred to as M1, M2, and M3 respectively following the sequence of their origin.

The frequencies of stomata and common subsidiaries of the three species are given in Table I, for comparison. A cell is counted as a common subsidiary if it is shared by a minimum of two stomata (Figs. 2 A and 3 E). Common subsidiaries flanked by three or four stomata are rare (Figs. 1 E and 3 D) as compared to those by two in the three species. From the data (Table I) it is clear that the more the common subsidiaries, the more are stomata per square millimeter in the species studied. It is, however, necessary to state here that frequency of stomata is not governed merely by the common subsidiaries. It is affected by the size of the epidermal cells as well as of the stomata, the details of which are to be published elsewhere. Information on the origin of the common subsidiaries in the three species is as follows:

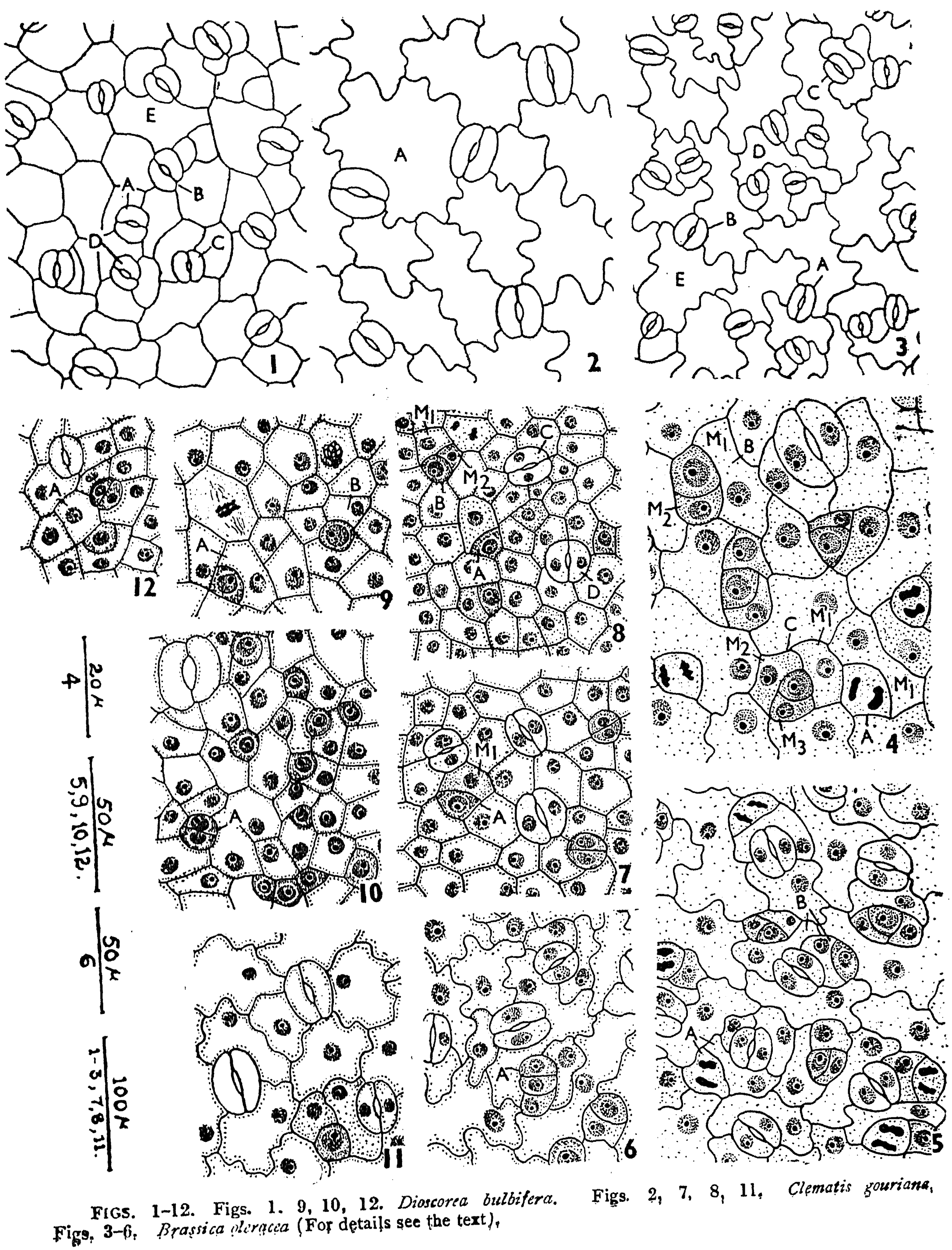
TABLE I

Species		Leaf abaxial surface	
		Common subsidiaries per square millimeter Ca.	Stomata per square millimeter Ca.
Clematis gouriana Roxb.	..	24	49
Dioscorea bulbifera L.	..	90	188
Brassica oleracea L.	..	208	318

Brassica oleracea.—The leaves bear about 208 common subsidiaries per millimeter square. The stomata are anisocytic, monocylic, diffusely distributed, oriented at random (Fig. 3). The subsidiaries and normal epidermal cells are alike being sinuous and smooth-surfaced. As seen from Fig. 3 A-C, often 2 or 3 subsidiaries of a stoma act as common subsidiaries. The stomata are mesogenous and trilabrate in origin (*see* Fig. 4 A-C) with the last subsidiary being the smallest (Fig. 4 C, M 3). The stomata produced in the very early stages are independent from one another as seen in peels from leaf primordia, 2·5 cm. long (Fig. 4); but in those from about 5 cm. long, origin of common subsidiaries can be observed (Fig. 5). In the latter peels one (Fig. 5 A), or more (Fig. 5 B) subsidiaries of the stomata, earlier differentiated, act as meristemoids dividing unequally, of which the larger cell becomes the common subsidiary, whereas the smaller one, through further divisions, gives rise to a new stoma. The common subsidiary differentiated is thus mesogenous to both its stomata. It will be flanked by three or more stomata, if additional stomata appear abutting on it from the other sides (Fig. 6 A). But it is difficult to determine whether these stomata originate from the common subsidiary already formed or from the adjacent cells. Origin of stomata and common subsidiaries in this manner continues till the leaves have grown to about 10·5 cm. long when the stomatal mesogenes and other epidermal cells all appear completely differentiated possessing deeply sinuate walls (Fig. 6) as in mature leaves (Fig. 3). From the observations it is clear that it is due to the labile nature of largely the stomatal mesogenes that common subsidiaries originate in the species.

Clematis gouriana.—The common subsidiaries are about 24 per millimeter square (Table I). The stomata are anomocytic, diffusely distributed and randomly oriented (Fig. 2). The subsidiaries and epidermal cells are all alike. The stomata are mesoperigenous and dolabrate in their ontogeny as only two of the subsidiaries are mesogenous (the first subsidiary—M 1, however, vacuolates quite early, *see* Fig. 8 B), whereas the rest are perigenous (Fig. 8 A, B). The initially formed stomata, which are seen in peels of leaf primordia about 0·5 cm. long, are without common subsidiaries (Fig. 8 C, D), but in peels of primordia over a cm. long, subsidiaries of certain stomata, already formed, become activated as stomatal meristemoids (Fig. 7 A). Since the mesogenes of the stomata mature early, it is difficult to judge whether the subsidiary acting as stomatal meristemoid is mesogenous or perigenous. As described in the previous species, the larger mesogene (M 1), produced through the unequal division of the meristemoid, becomes the common subsidiary (Fig. 7 A). If the subsidiary acting as meristemoid is mesogenous, the common subsidiary formed is obviously mesogenous to both the stomata concerned; otherwise it will be perigenous to the first formed stoma, and mesogenous to the later one. Subsidiaries shared by three or four stomata also appear at this stage, but the ontogenetic relationship of such common subsidiaries with the stomata concerned is difficult to determine due to their belated origin. Origin of stomata giving rise to common subsidiaries may continue for long, as in *Brassica* (*see* Fig. 11).

Dioscorea bulbifera.—The epidermis shows about 90 common subsidiaries per millimeter square, but the stomata possessing the common subsidiaries occur in aggregates (Fig. 1 A-D). The stomata are mostly anomocytic, diffusely distributed and randomly oriented. The subsidiaries and normal epidermal cells bear straight to curved walls and the two are not mutually distinctive (Fig. 1). The stomatal meristemoids start appearing when the leaf primordia are about 2 cm. long (Fig. 9). Through an unequal division, a protodermal cell divides into two cells (Fig. 9 A), of which the larger forms a mesogene, whereas the smaller one develops into a stoma by undergoing a division (Fig. 10 A). The larger cell is recognisable as a mesogene in the early ontogeny only topo-



FIGS. 1-12. Figs. 1. 9, 10, 12. *Dioscorea bulbifera.* Figs. 2, 7, 8, 11, *Clematis gouriana*, Figs. 3-6, *Brassica oleracea* (For details see the text).

graphically (Fig. 9 A), for its contents exhaust quite rapidly. The first formed meristemoids are distanced from each other by two or more cells (Fig. 9 A, B), but by the time the leaf primordia are about 6·5 cm. long, clusters of abutting protodermal cells start functioning as meristemoids and produce stomata as described above (Fig. 10). From the figure it is clear that the stomata so originate (as indicated by the meristemoids) that one stoma will come to abut on the mesogene of the other, so that the mesogene becomes a common subsidiary. Subsidiary of this kind will be obviously mesogenous to its own stoma, but perigenous to the one adjacently formed. Occasionally, however, a common subsidiary is seen which is perigenous to all its abutting stomata as seen from Fig. 12 A. In the latter, a common subsidiary is flanked by a guard cell mother cell (which will turn into a stoma by the next division) on one side and a young stoma on the other. From the topography of the guard cell mother cell and the young stoma it is clear that they are derived from adjacent cells.

The observations lead to several interesting conclusions. Common subsidiaries are associated with stomata irrespective of their ontogenetic pattern (whether mesogenous, mesoperigenous or perigenous). The first formed stomata do not possess any common subsidiaries, the latter appearing only in the subsequent period due to origin of fresh stomata either from or close to the subsidiaries of stomata already formed. Formation of common subsidiaries may last nearly upto the maturation of the leaf as in *Brassica*. No evidence is noted in favour of Bunning's[1] hypothesis that stomata originate at points beyond the range of inhibitory fields of previously formed stomata (as seen from Figs. 10, 12 and 5 B). In terms of their ontogenetic relationship, common subsidiaries are recognisable into three types; they may be (1) mesogenous to the stomata concerned or (2) mesogenous to some and perigenous to the others or (3) perigenous to one and all.

We express our gratitude to Prof. M. R. Suxena for facilities and encouragement. One of us (TR) is thankful to the Council of Scientific and Industrial Research, New Delhi, for the award of a Senior Research Fellowship.

---

1. **Bunning. E., "General processes of differentiation in the growth of leaves,"** ***The Growth of Leaves*****, Ed. Milthrope. F. L., Butterworth Sci. Publ., London, 1956, p. 18.**

ENVIRONMENTAL POLLUTION

To recognize a problem is the first step towards its solution but it is certainly not enough. This was clearly expressed by Dr. M. G. Candau, Director-General of the World Health Organization in the presentation of his annual report to the World Health Assembly. This is what he said: "We have to develop a simple and effective international detection and warning system designed for studying at the level of the city, nation and even continent the factors which modify our environment thus enabling us to overcome a problem which is, indeed, ours but which we must resolve not to hand on to our children. Such a detection system may be considered as the application of epidemiology to ecology. Its development would require a structural and quantitative analysis of all the essential factors of the environment—physical, chemical, biological and psychological—in order to determine the indicators that can serve as alarm signals. This means that the international community must come to some agreement on the levels or thresholds beyond which hazards exist.

This, in Dr. Candau's opinion, would be the first stage of the project to be followed by other developments, as he went on to explain: "The data collected will in any case be useful, since they will improve the quality and quantity of the information already available to us. But beyond even a detection system such as I have just described in broad outline, we have to look ahead in the more distant future, as a subsequent step in this project, to a world information centre directly linked by computers to national and regional health services.

For many years now, WHO has been developing surveillance and monitoring activities in such fields as adverse reactions to drugs, the communicable diseases (including malaria and smallpox), pesticides, air and water pollutants and the micro-chemicals and their toxic and genetic effects on man. These and a host of other problems are very complex in nature and the critical data are lacking in practically every area. For the past several months we have been studying how to develop plans, short and long-term in nature, that will enable WHO to proceed more effectively in the task of defining and interpreting environmental influences on the health of man, and to take appropriate action.—(*Courtesy*: *WHO Press Release*.)

LETTERS TO THE EDITOR

THE CRYSTAL STRUCTURE OF HOMOPHTHALIC ACID, $C_9H_8O_4$

HOMOPHTHALIC acid, $C_9H_8O_4$, is a dicarboxylic acid and some of its salts have unusual crystal structures (Gupta and Dubey[1]). The crystal structure of the acid itself is of great interest as both the carboxyl groups in the same molecule are likely to form hydrogen bonds, across centres of symmetry, giving dimers.

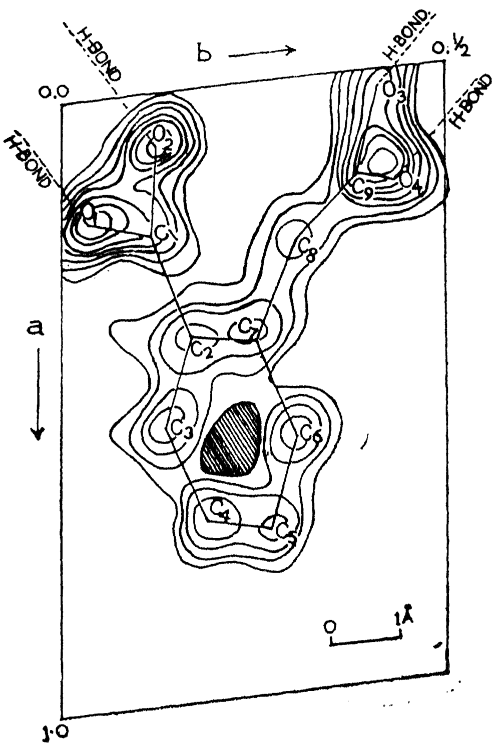


FIG. 1. The electron density projection looking down the [001] axis.

X-Ray Data.—The unit cell data are the same as reported by Gupta and Bose,[2] *viz.*, $a = 8 \cdot 45$ Å, $b = 10 \cdot 87$ Å, $c = 5 \cdot 23$ Å, $\alpha = 80°\ 3'$, $\beta = 116°\ 10'$, $\gamma = 96°\ 44'$, Number of molecules in the unit cell Z = 2, Space group, $P\bar{1}$. Complete zonal and three-dimensional data were collected with copper unfiltered radiation and Weissenberg photography (normal and equi-inclination). A total of ~600 independent reflexions were collected with non-zero intensity values. Patterson projections failed to give any clue to the structure. The structure was solved by using normalized structure factors and symbolic addition procedure. This gave a clue of the structure as looking down the [100] axis, which was, however, not the best resolved projection. Inequality relations and reiterative Fourier refinements gave the ultimate solution of the structure and the best resolved Fourier projection down the [001] axis is shown in Fig. 1. The R factors at this stage of analysis are $R(hko) = 0 \cdot 21$, $R(okl) = 0 \cdot 23$. In the crystal homophthalic acid molecules are linked through their carboxyl groups (COOH) across centres of symmetry, with hydrogen bonds of 2·66 Å and 2·61 Å. The geometry of the molecule and other intermolecular contacts are normal.

Department of Physics,
University of Ranchi,
Ranchi-8, *January* 15, 1970.

M. P. GUPTA.
D. S. DUBEY.
M. SAHU.

---

1. Gupta, M. P. and Dubey, D. S., *Curr. Sci.*, **1970**, **39**, **152**,
2. — and Bose, S., *Ind. Jour. of Phys.*, 1969, **43**, **45**.

MEAN SQUARE AMPLITUDES FOR THE IN-PLANE VIBRATIONS IN DIMETHYLFORMAMIDE AND DIMETHYLACETAMIDE

THE authors[1] carried out the normal co-ordinate treatment of N, N-dimethylformamide and N, N-dimethylacetamide, and the magnitude of the mixing of the various skeletal frequencies in these molecules was estimated by calculating the potential energy distribution of each normal mode among the various symmetry co-ordinates. We now report the mean square amplitudes of vibration of the various linkages in N, N-dimethylformamide and N, N-dimethylacetamide.

The mean square amplitude of vibration is given by

$$\Sigma = L \Delta \tilde{L} \qquad (1)$$

where L is the transpose of the L matrix and Δ is a diagonal matrix with the elements

$$\Delta_k = \langle Q_k^2 \rangle = \frac{h}{8\pi^2 \nu_k} \coth\left(\frac{h\nu_k}{2KT}\right) \qquad (2)$$

$\langle Q_k^2 \rangle$ is the mean square of the K^{th} normal co-ordinate. The mean square amplitudes of vibrations and the mean amplitudes at temperatures 0° K and 300° K are given in Table I.

TABLE I

Mean square amplitudes and mean amplitudes of vibrations of various linkages in N, N-dimethylformamide and N, N-dimethylacetamide

Bond and mode of vibration	Molecule	Mean square amplitude (in Å^2)		Mean amplitude (in Å)	
		T=0° K	T=300° K	T=0° K	T=300° K
$\nu_{as}\left(\mathrm{N}\begin{matrix}\diagup\mathrm{CH_3}\\ \diagdown\mathrm{CH_3}\end{matrix}\right)$	DMF	0·002431	0·002512	0·0493	0·0501
	DMA	0·002401	0·002453	0·0490	0·0495
$\nu_{s}\left(\mathrm{N}\begin{matrix}\diagup\mathrm{CH_3}\\ \diagdown\mathrm{CH_3}\end{matrix}\right)$	DMF	0·001813	0·001935	0·0426	0·0440
	DMA	0·001823	0·001920	0·0427	0·0438
ν (C—H)	DMF	0·006787	0·006801	0·0824	0·0825
ν (C—CH$_3$)	DMA	0·003000	0·003223	0·0548	0·0568
ν (C=O)	DMF	0·001634	0·001645	0·0404	0·0406
	DMA	0·001652	0·001668	0·0406	0·0408
ν (C—N)	DMF	0·001982	0·002031	0·0427	0·0451
	DMA	0·001869	0·001922	0·0432	0·0438

The mean amplitude of vibration of C=O stretch has the lowest value and that of C—H has the highest value as expected. The variation of the mean amplitude of vibration of C—H linkage with temperature is relatively low compared to those of the other linkages.

One of the authors (V. V. C.) expresses his thanks to Dr. B. Purnachandra Rao, P.G. Centre, Anantapur, for giving facilities for these computations.

Dept. of Physics, V. VENKATA CHALAPATHI.
S.V.U. P.G. Centre,
Anantapur, A.P.
and
Dept. of Physics, K. VENKATA RAMIAH.
Post-Graduate Centre,
(Osmania University),
Warangal (A.P.), *January* 19, 1970.

---

1. Venkata Chalapathi, V. and Venkata Ramiah, K., *Proc. Ind. Acad. Sci.*, 1968, **68**, 109.

DOMAINS IN FERROELECTRIC POTASSIUM NIOBATE SINGLE CRYSTALS

POTASSIUM NIOBATE, KNbO$_3$, belongs to the family of ferroelectric perovskite type oxides and follows the same sequence of phase transitions as BaTiO$_3$.[1] The domains in BaTiO$_3$ have been studied in detail by various investigators[2-5] but no work on domains in KNbO$_3$ has been reported, probably because of the difficulty in growing good single crystals which are not highly twinned. We have grown these single crystals[6] suitable for domain study. Since KNbO$_3$ exists in orthorhombic phase at room temperature, 60° domains along with 90° and 180° walls are obtained.

180° domains were revealed when thin crystal flakes were etched in H$_2$O$_2$ and it was observed that a depression on one face corresponded to an elevation on the other face because of the preferential dissolution with respect to the polar axis. These domains were found to be mostly cylindrical. 60° and 90° domains were observed and studied by optical and multiple beam interferometry methods.

60° domains are formed by twinning on pseudocubic (011) planes or orthorhombic (111) planes.[2] These planes pass through the body of the crystal, making an angle of nearly 45° with the edges of a pseudocubic (001) plane. The polarising microscope clearly reveals these domains in thin crystal plates. It was found that while one domain exhibited symmetrical exitinction, the neighbouring domain across the domain wall showed parallel extinction. This is, indeed, to be expected since the polar axes in the 60° domains lie in perpendicular planes.

90° domains are formed by twinning on pseudocubic (001) planes or orthorhombic (110) planes.[2] Transmission photographs taken on a transparent sample grown on the bed of flux revealed the domain walls going through the body of the crystal at an angle of 90° with the major surface which was pseudocubic (001) plane. Clearly, the domain walls were 90° domains. This was confirmed with the polarizing microscope when symmetrical extinction in both the domains across the domain wall was observed, and rotation of the crystal stage through 90° resulted in bright regions getting dark and dark regions bright, showing the existence of 90° domains with polar axes in the observed plane and perpendicular to each other.

These 60° and 90° domains are found to appear in a variety of combinations in the crystals. Figure 1 is a very good example of complex domain patterns that can arise. 90° domain lines are very faint and barely visible and are always parallel to the pseudocubic edges. In contrast, 60° domain lines are quite sharp and can lie either parallel or symmetrical to the edges on the pseudocubic (001) plane. In Fig. 1 both 60° and 90° domain lines are seen parallel to pseudocubic edges. As 60° and 90° domains produce distinctive surface deformations,[5] they are easily identified as 60° or 90° domain lines by obtaining the multiple beam interferogram over the same crystal surface. Figure 2 is such an interferogram over the crystal surface of Fig. 1. 60° domains are seen to be inclined across the domain line at an angle of 57′, and 90° domains at an angle of nearly 30′. Also head-to-head or tail-to-tail coupling of dipoles (Portion AB) is seen at places along with the usual head-to-tail coupling that gives rise to step ladder structure.

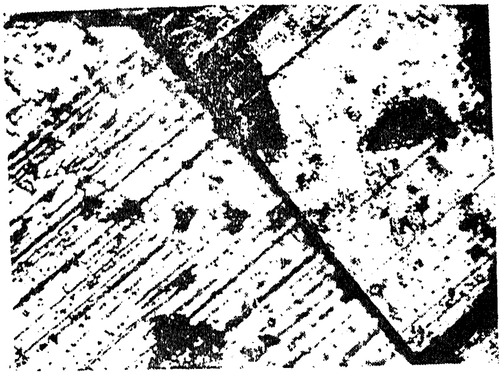


FIG. 1. Microphotograph of $KNbO_3$ crystal surface.

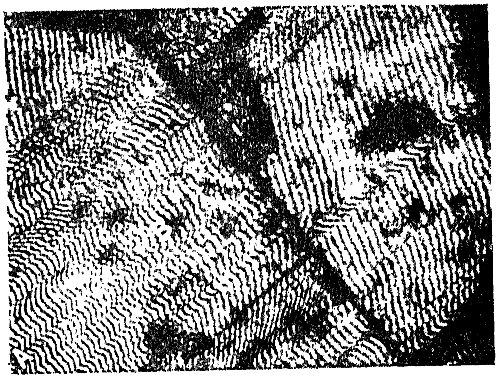


FIG. 2. Interferogram over the same crystal surface.

Interferograms on a number of crystals also revealed the existence of sharp surface angles, curvatures and wedges. These surface angles and curvatures can be explained to be due to the presence of wedges. In contrast to 90° wedges, in the tetragonal $BaTiO_3$, these wedges in $KNbO_3$ are 60° wedges. The wedge angle is found to be 57′. These wedges usually originate from the edge of the crystal and can be moved with the slight application of stress. After releasing the stress, they generally return to their original position.

The surface angles and angles between the planes across 90° and 60° domain walls are found to be temperature-dependent. They decrease with temperature upto the phase transition at 225° C. when a new domain pattern of tetragonal phase, resembling the domain pattern of the orthorhombic phase in many cases, is set up which persists upto the Curie transition at 435° C., after which the surface deformation vanishes completely with the ferroelectric nature of the crystal. In the tetragonal phase the surface deformations and their variation with temperature are similar to those found in tetragonal $BaTiO_3$.[4,5]

Dept. of Applied Physics, K. G. DESHMUKH.
Visvesvaraya Regional
College of Engineering, Nagpur,
and
Laxminarayan Institute S. G. INGLE.
of Technology, Nagpur University,
Nagpur, *February* 25, 1970.

---

1. Matthias, B. T. and Remeika, J. P., *Phys. Rev.*, 1951, **82**, 727.
2. Forsberg, P. W. Jr., *Ibid.*, 1949 **76**, 1187.
3. Kay, H. F. and Vousden, P., *Phil. Mag.*, 1949, **40**, 1019.
4. Bhide, V. G. and Bapat, N. J., *Jour. Appl. Phys.*, 1963, **34**, 181.
5. — and Chinmulgund, N. D., *Ind. Jour. Pure and Appl. Phys.*, 1965, **3**, 253.
6. Deshmukh, K. G. and Ingle, S. G., *Nuclear Physics and Solid State Physics Symposium*, Dec. 28–31, 1969, Abstract No. S 94.

KINETICS OF OXIDATION OF p-METHOXYACETOPHENONE BY MANGANESE(III) SULPHATE

A SYSTEMATIC study of the oxidation of ketones by manganese (III) sulphate was undertaken by the authors to investigate the role of the enol form in the oxidation process. The present communication is about the results of oxidation of p-methoxyacetophenone by Mn(III).

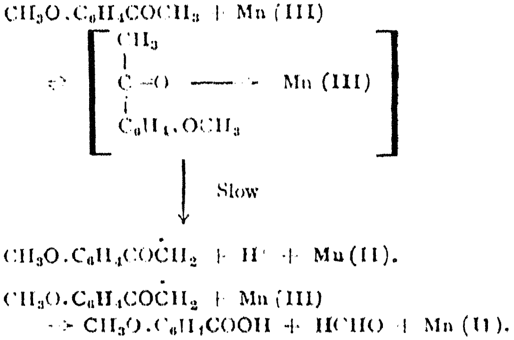
The reactions were carried out in 20% acetic acid solution. The rate at which Mn(III) disappears followed first-order rate law and at constant ionic strength the rate is independent of acidity. The rate showed a first-order dependence on the concentration of the ketone. The oxidation rate is unaffected by changes in percentage of acetic acid in solution

(20-60%) and by addition of Mn(II). The reaction was studied at different temperatures from 30°-45° C. and thermodynamic parameters calculated.

The enolisation rate of *p*-methoxyacetophenone was measured by bromination method and is of first order with respect to the ketone and hydrogen ion individually, and of zero order to bromine. The higher concentration of acetic acid (20-80%) results in increased enolisation rate at 35° C. ($k_2 = 2 \cdot 63 \times 10^{-4}$ – $7 \cdot 76 \times 10^{-4}$ l. mole^{-1} sec.$^{-1}$).

The oxidation of ketones by Mn(III) pyrophosphate was postulated *via* enolisation.[1] The kinetics of the oxidation and enolisation of *p*-methoxyacetophenone are different and enol form is not likely to be involved in the oxidation process. At 35° C. and in 20% acetic acid solution the enolisation rate is $2 \cdot 63 \times 10^{-4}$ l. mole^{-1} sec.$^{-1}$ while the oxidation rate under similar condition is $26 \cdot 5 \times 10^{-4}$ l. mole^{-1} sec.$^{-1}$. Thus the oxidation is faster than enolisation and the oxidation involved the attack on the keto-form by Mn(III), which also supports the observation of Littler.[2]

The following mechanism may be suggested:



$$CH_3O.C_6H_4COCH_3 + Mn(III) \rightarrow \left[\begin{array}{l} CH_3 \\ | \\ C=O \longrightarrow Mn(III) \\ | \\ C_6H_4.OCH_3 \end{array}\right] \xrightarrow{Slow} CH_3O.C_6H_4CO\dot{C}H_2 + H^+ + Mn(II).$$

$$CH_3O.C_6H_4CO\dot{C}H_2 + Mn(III) \rightarrow CH_3O.C_6H_4COOH + HCHO + Mn(II).$$

The energy of activation and entropy of activation as calculated from results at different temperatures are 17·5 kcals mole^{-1} and −14·2 e.u. respectively.

Formaldehyde was mainly the identified product and its estimation by chromotropic acid[3] suggested a 4 : 1 stoichiometry for Δ Mn(III)/Δ *p*-methoxyacetophenone.

Department of Chemistry, P. Nath.
University of Jodhpur, K. K. Banerji.
Jodhpur (India), *March* 18, 1970.

---

1. Drummond, A. Y. and Waters, W. A., *J. Chem. Soc. (London)*, **1953**, p. 435.
2. Littler, J. S., *Ibid.*, **1962**, p. 832.
3. Mitchell, J. Jr., *Organic Analysis*, Interscience Publishers, New York, 1953, **1**, 288.

OXIDIMETRIC DETERMINATION OF THALLIUM (I)

Bishop and Jennings[1] have reported that thallium (I) can be determined accurately by potentiometric titration with chloramine-T in 3-4 M hydrochloric acid in presence of iodine monochloride as reaction intermediate. It has been found in the present studies that aqueous chloramine-T solution is unstable in 3-4 M hydrochloric acid medium. Hence, it is always desirable to work at lower acidities in the range 0·1-0·2 M hydrochloric acid as chloramine-T solution is quite stable under these conditions. But the oxidation of thallium (I) with chloramine-T in 0·1-0·2 M hydrochloric acid medium is very slow. An alternative method would be to oxidise thallium (I) with chloramine-T in 2-4 M hydrochloric acid medium, destroying the unused chloramine-T and then determining thallium (III) iodometrically. We found that chloramine-T can be completely destroyed by excess dimethylsulphoxide in 1-2 M hydrochloric acid medium. Dimethylsulphoxide and its oxidised product dimethylsulphone are inert to thallium(III), potassium iodide and iodine under these conditions.

The chloramine-T-thallium (I) reaction was studied under diverse conditions to find out the optimum conditions for achieving quantitative oxidation of thallium (I). For this purpose, solutions containing 0·5-1 m. mole of thallium (I) were conditioned variously and then excess chloramine-T or chlorine water (20 ml. of 0·1 N) was added. The reaction mixture was set aside for definite length of time. Then excess dimethylsulphoxide (20 ml of 0·2 M) was added and the overall acidity was adjusted to 1 M by adding concentrated hydrochloric acid. This destroyed the excess of the chlorine oxidants. Then 15 ml. of 10% potassium iodide was added and the iodine liberated due to thallium (III) reduction was titrated with standard thiosulphate solution after the addition of 10 ml. of 2% starch solution.

The results presented in Table I indicate that oxidation of thallium (I) with chloramine-T is very slow in sulphuric acid and in sodium hydroxide media. At pH 4·7, the rate of the oxidation is very much higher but still not sufficient to produce quantitative oxidation within 15 minutes. However, in presence of excess chloride ions (overall concentration > 0·5 N) the oxidation was favoured not only at pH 4·7 but also at higher acidities to such an extent that quantitative oxidation resulted within 5–10 minutes. Based on this the following procedure is recommended for the accurate determination of thallium (I).

TABLE I

Oxidation of thallium (I) with chloramine-T and chlorine water (m. equivalents of chloramine-T or chlorine added = 2·500 ; overall volume = 100 ml.

Medium	Tl (I) taken mM	Standing time min.	Iodometric titre value m. equiv.	4/2
0·2N H_2SO_4 ..	0·9543	60	0·287	0·3008
0·2N NaOH ..	0·9543	60	0·146	0·1531
2M HCl ..	0·7157	5	1·432	2·001
3M HCl ..	0·7157	5	1·429	1·997
pH 4·7 ..	0·9543	10	1·708	1·790^a
	0·9543	60	1·827	1·915^a
	0·9543	5	1·819	1·906^b
	0·9543	15	1·903	1·995^b
	0·9543	5	1·907	1·999^c
	0·9543	5	1·905	1·996^d

(^{a}) No chloride was added Overall concentration of sodium chloride was 0·5N in (^{b}), 1·0N in (^{c}), and 2·0N in (^{d}).

To 80 ml. of the solution containing 0·5–1 m. mole of thallium (I) and 2M hydrochloric acid, excess chloramine-T or chlorine water (20 ml. of 0·1 N) is added. After about 5 minutes 20 ml. of 0·2 M dimethylsulphoxide is added. Then 15 ml. of 10% potassium iodide is added and the iodine liberated by the thallium (III) is determined with thiosulphate. The results obtained were accurate to within 0·3%. Instead of chloramine-T, chlorine water of comparable strength can also be used in the above procedure.

Dept. of Chemistry, V. R. S. RAO.
Indian Institute of Tech., G. ARAVAMUDAN.
Madras-36, *January* 15, 1970.

---

1. Bishop, E. and Jennings, V. J., *Talanta*, 1962, **9**, 679.

MAGNETIC AND INFRA-RED SPECTRAL STUDIES ON DITHIOCYANATO-o-PHENANTHROLINE-VANADIUM (IV) COMPLEX

IT has been earlier reported that vanadium(IV) forms a mixed ligand complex with o-phenanthroline and thiocyanate.[1] The solid complex separates from the aqueous medium at pH 2. This gets extracted into *n*-butanol, and spectrophotometric and solvent extraction studies showed the composition of the complex to be $[VO(ROH)(Phen.)(SCN)_2]$. We are now reporting the infra-red absorption and the magnetic moment of the solid complex that was isolated.

The infra-red spectrum was recorded on Nujol mull using Unicam SP200 Spectrophotometer with rock-salt optics. The main features of the spectrum are as follows: (1) There is no characteristic band attributable to co-ordinated water in the region 3400 cm.$^{-1}$; this signifies that co-ordinated water molecule is definitely absent in the complex. (2) The sharp band at 2040 cm.$^{-1}$ due to C–N stretching frequency indicates the presence of terminal (and not bridging) thiocyanate groups bonded through nitrogen.[2,3] (3) The sharp band at 960 cm.$^{-1}$ indicates definitely the presence of V=O bonding in the complex.[4] (4) The sharp bands at 715 cm.$^{-1}$ and 845 cm.$^{-1}$ are due to the bonded ligand, *o*-phenanthorline.[5]

The magnetic susceptibility measurement was made on a solid sample at room temperature using Guoy method and the μ_{eff} value was found to be 1·91 B.M., on the basis that its formula is $VO(Phen.)(SCN)_2$. This clearly indicates the presence of one unpaired electron which is in conformity with the presence of quadrivalent vanadium in the complex.

It is therefore concluded that in the solid state, the complex is probably a penta co-ordinated monomer having the composition $[VO(Phen.)(SCN)_2]$ and when dissolved in *n*-butanol, a solvent molecule is co-ordinated in the sixth position of the octahedron as was generally assumed by Clark.[6]

Chemistry Dept., V. PANDU RANGA RAO.
A.U. Post-Graduate P. V. R. BHASKARA SARMA.
Centre,
Guntur-5 (A.P.),
and
Post-Graduate D. V. RAMANA RAO.
Department of Chemistry,
Regional Engineering College,
Rourkela-8, Orissa, *February* 23, 1970.

---

1. Pandu Ranga Rao, V. and Bhaskara Sarma, P. V. R., *J. Inorg. Nucl. Chem.*, 1969, **31**, 2141.
2. Turco, A. and Pecile, C., *Nature*, 1961, **191**, 66.
3. Burmeister, J. L. and Basolo, F., *Inorg. Chem.*, 1964, **3**, 1587.
4. Nakamoto, K., *Infra-red Spectra of Inorganic Coordination Compounds*, John Wiley & Sons, 1963, p. 221
5. Schilt A. A. and Fritsch, K., *J. Inorg. Nucl. Chem.*, 1966, **28**, 2677.
6. Clark, R. J. H., *J. Chem. Soc.*, 1963, p. 1377.

CHEMICAL STUDY OF PIPER BETEL LEAVES

ABSTRACT

Pentatriacontane, *n*-triacontanol, hentriacontane, stearic acid, chavicol, β and γ-sitosterols have been isolated from the leaves of Piper betel and characterised.

THE leaves of Piper Betel (Vern-Pan, Banarasi) used most frequently for chewing purposes, are reported to have various medicinal properties, as mentioned in ancient Indian Ayurvedic texts.[1] Its action over the heart[2] (cardiotonic effect) has prompted us to undertake a systematic chemical examination of these leaves.

The powdered leaves (1·5 kg.) extracted successively with petroleum ether (40–60), benzene and alcohol, and combined petroleum ether, benzene extract yielded β-sitosterol[3] [$\nu^{KBr}_{max.}$ 2·9 (OH), 3·4 ($-CH_3$), 6 ($>C=C<$), 10·45 (Δ 22–23) and 11·8 (Δ 5)μ], m.p. 136°, acetate 130° and γ-sitosterol, m.p. 145°, m.m.p. 145° and acetate, m.p. 141°.

Final confirmation of these substances was achieved by mixed melting point determination and from superimposable I.R. Hentriacontane[3] ($\nu^{KBr}_{max.}$ 3·43, 4·32, 4·98, 5·72, 5·12, 6·78, 8·16, 13·60 and 13·78 μ), m.p. 62–63°, *n*-triacontanol[4] [$\nu^{KBr}_{max.}$ 2·94 (OH), 3·51 (CH_3), 4·93, 6·89, 13·78, 14·8 μ, m.p. 71°, acetate, m.p. 68° and a hydrocarbon which appears to be pentatriacontane [$\nu^{KBr}_{max.}$ 3·5, 6·9, 7·3, 13·75 and 13·9 μ; NMR 1·27 δ (66 H, CH_2), 0·88 δ (6H, CH_3)], m.p. 74° (Found : C, 85·6 ; H, 14·5 ; $C_{35}H_{72}$ requires : C, 85·3 ; H, 14·6%) were isolated as usual from this fraction after chromatography over alumina column. The identity of these compounds was duly established.

The saponifiable portion gave only stearic acid after lead salt-ethanol process[5] ; its identity was confirmed from S.E., I.V. data and from mixed melting point determination (69°). Furthermore, ester fractionation and co-chromatography with an authentic sample of same over thin layer plates of silica gel G proved its identity finally as stearic acid. It has been also possible to identify chavicol,[3] 3 : 5 dinitrobenzoate, m.p. 104°, present in the leaves of this species.

The alcoholic extract yielded a brownish powder after precipitation with ether, and this responded for the tests of cardiotonic glycosides.[6] This showed a marked cardiotonic effect over anæsthetised dog, and is found to contain glucose units only.

Thanks are due to Prof. G. B. Singh for providing necessary facilities, to Prof. P. V. Sharma for plant material and cardiotonic testing. A generous gift of γ-sitosterol by Dr. S. K. Talpatra is gratefully acknowledged. One of us (R. R. U.) is thankful to C.S.I.R. for the award of a Senior Research Fellowship.

Department of Chemistry, S. M. DESHPANDE.
Faculty of Science, R. R. UPADHYAY.
Banaras Hindu University, R. P. SINGH.
Varanasi-5, *January* 18, 1970.

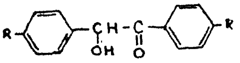
---

1. *Charaka Samhita*, Sutra V, 77, 3rd edition, Nirnaya Sagar, Bombay, 1941.
2. *Sushruta Samhita*, Ch. XXIV (1924), 3rd edition, Nirnaya Sagar, Bombay, 1939 ; *Raj Nighantu III*, 131, 2nd edition, Anandashrama, Poona ; *Dhanwantari Nighantu III*, 131, 2nd edition, Anandashrama, Poona, 1925.
3. Heilborn, I. and Bunbury, H. M., *Dictionary of Organic Compounds*, Eyre and Spottes Woode, London, 1953, Vols. 1, 2 & 4, pp. 449, 636, 316 and 69.
4. Robinson, G. M., *J. Chem. Soc.*, 1934, p. 1545.
5. Hilditch, T. P., *The Chemical Constitution of Natural Fats*, Chapman and Hall Ltd., London, 1947, p. 468.
6. Fieser, L. F. and Fieser, M., *Steroids*, Reinhold Publishing Corporation, New York, 1959, p. 734.

WOLFF-KISHNER REDUCTION OF α-HYDROXY KETONES

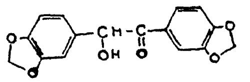
IN the course of structural study of tanginol, a hexahydroxy triterpene isolated in these laboratories from *Barringtonia acutangula* Gaertn.[1,2] an interesting observation was made. The Wolff-Kishner reduction, under the forced conditions of Barton, Ives and Thomas,[3] of 6-keto tanginol pentabenzoate, reduced both 6-keto and 7-benzoyloxy groups to methylene groups.[4] This appears to be the first of its kind. This unusual observation made us to study the Wolff-Kishner reduction of some α-hydroxy ketones. In the present investigation, benzoin (I), anision (II) 3, 4, 3′, 4′-dimethylene-dioxy-benzoin (III) and their benzoates are subjected to reduction by Wolff-Kishner method as modified by Huang-Minlon.

The product from benzoin was identified to be mainly dibenzyl (IV) (colourless prisms from ethanol, m.p. 52°, analysed for $C_{14}H_{14}$ lit.,[5] m.p. 53° for dibenzyl) in a yield of 30% and a small quantity of resinous product. But no benzilic acid could be discovered in the reaction mixture. On the other hand, when benzoin benzoate was used, besides dibenzyl, a yellow nitrogenous product (bright yellow needles from ethanol, m.p. 165°, analysis C, 84·37 and H, 6·08%. I.R. (nujol) 1595 cm.^{-1}, 1568 cm.$^{-1}$, 1495 cm.$^{-1}$, 1465 cm.$^{-1}$, 1455 cm.$^{-1}$ (w), 1445 cm.$^{-1}$ (w), 1378 cm.$^{-1}$, 1275 cm.$^{-1}$, 1155 cm.$^{-1}$, 1070 cm.$^{-1}$, 925 cm.$^{-1}$, 780 cm.$^{-1}$ (w), 755 cm.$^{-1}$, 720 cm.$^{-1}$, 695 cm.$^{-1}$ (w) and 685 cm.$^{-1}$ was obtained in an yield of 30%. This product may be the azine and its structure is under study.

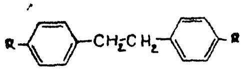


I. R = H

II. R = OCH_3



III



IV. R = H

V. R = OCH_3

Anisoin and its benzoate on Wolff-Kishner reduction followed by methylation with diazomethane yielded p, p′-dimethoxy dibenzyl (colourless plates from ethanol, m.p. 125°, analysed for $C_{16}H_{18}O_2$). Sulphuric acid solution of the compound turned deep red with a drop of $FeCl_3$, lit,[5,6] m.p. 125° for p, p′-dimethoxy dibenzyl.

Wolff-Kishner reduction of 3, 4, 3′, 4′-dimethylene dioxy benzoin was unstable under Wolff-Kishner conditions and yielded a dark brown semi-solid.

The mechanism suggested by Weygand[7] for the formation of diphenyl hydrazone by the action of phenyl hydrazane on α-hydroxy carbonyl compounds (sugars) seems to be operating even in the present instance. The formation of *bis*-1, 2-hydrazone may be inferred as an intermediate in the Wolff-Kishner reduction of the α-hydroxy ketones.

We express our thanks to Prof. L. Ramachandra Row, for continuous encouragement and discussion during this work.

Dept. of Chemistry, T. SUNDARARAMAIAH.
Andhra University, C. SANKARA RAO.
Waltair, *February* 4, 1970.

---

1. Ramachandra Row, L. and Prakasa Sastry, C. S., *Indian J. Chem.*, 1963, **1**, 322.
2. — and —, *Ibid.*, 1964, **2**, 463.
3. Barton, D. H. R., Ives, I. J. and Thomas, B. R., *J. Chem. Soc.*, 1956, p. 2056.
4. Prakasa Sastry, C. S., *Ph.D. Thesis*, Andhra University, 1965, p. 104.
5. Johannes, S. Buck and Sanford, S. Jenkins, *J. Amer. Chem. Soc.*, 1929, **51**, 2163.
6. Freund and Reitz, *Ber.*, 39, 2239 (Beilstein), Band VI, System 563, 1944, p. 1000.
7. Weygand, F., *Ibid.*, 1940, **73**, 1259.

A NOTE ON "PALAEOBATHYMETRY OF THE REEF CARBONATES AT THE BASE OF TRICHINOPOLY UPPER CRETACEOUS, S. INDIA"*

"THE depth at which a sediment and its associated fauna were deposited is one of the most evasive pieces of environmental evidence sought by sedimentary geologists" (Swinchatt, 1969). Paleontology offers conflicting and mutually contradictory evidence to this effect (Newmann, 1967; Hornibrook, 1968). But paleobathymetry is of importance in the reconstruction of past depositional environment in epieric and shelf seas. The petrographic evidence of algal micritic envelopes around carbonate skeletal fragments seems to offer a semiquantitative lead in this direction (Swinchatt, *op. cit.*).

An extensive sedimentological investigation of the Reef Carbonates at the base of Trichinopoly Upper Cretaceous, S. India (Rao, 1969) revealed the occurrence of algal micritic envelopes (algal borings) (Fig. 1) around carbonate skeletal fragments. Some of the fragments are completely corroded and reduced to algal micrite. Besides, broken irregular fragments, elongated ribbons, plates, crusts of Rhodophyceæ algæ are present. Algal grain types, like pseudo-stromata, algal coated grains, stem segments, fragments and cells (Wolf, 1965) are common. These evidences prove that grain diminution by algal boring is extensive in these limestones. Much of the coarser spar acting as a binding medium to framework carbonate grain types may as well be aggradational neomorphic product of original algal micrite (Rao, *op. cit.*)

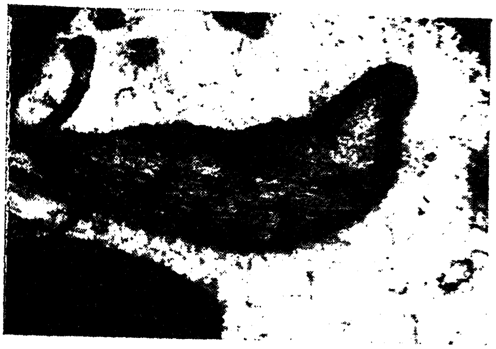


FIG. 1. Photomicrograph of an organic fragment with algal micritic envelope. The grain is entirely corroded (dark part) and micritisation has progressed even to the central part of the fragment. The surrounding spar is neomorphic in origin from the original algal micrite, × 15.

Swinchatt (1969) has shown that algal boring of skeletal fragments is common in Florida and

Bahama Shelf sediments and practically absent beyond a depth of 60 ft. in the shelf apron of Arlington Reef complex of Great Barrier Reef, Australia. If one could relate algal boring to metabolic activity of algæ, and this to availability of solar energy, then, it is seen, that solar energy generally reaches a depth of 50 to 60 feet in clear water (Hassland, 1949) and exceptionally to a depth of 130 feet (Nadson. 1927). If this is so, then the abundance of micritic envelopes around skeletal fragments in Florida and Bahama shelf sediments is due to clearness of water and shallow depth (50–60 ft.), and absence of borings in shelf sediments of Arlington Reef, to greater depths (beyond 60 ft.). This is true, if there is no reworking of the sediments (Swinchatt, 1969). In the Reef carbonate of the Trichinopoly Upper Cretaceous, especially in Dalmiapuram Limestone, algal borings are seen both in the core and the reef flank facies and thus suggests minimum reworking of the detritus. Therefore, it may be presumed that the carbonates were deposited in an environment of clear water at a depth of 50–60 feet and in all probability at no greater depths than 130 feet. This would further suggest, the shallowness of the sea over much of, at least, Utatur Stage of Trichinopoly Upper Cretaceous.

Institute of Petroleum Exploration,
ONG Commission, Kaulagarh Road,
Dehra Dun, *March* 2, 1970.

C. GUNDU RAO.

***Note published with the kind permission of Member Exploration, ONG Commission, Dehra Dun.**

1. Hessland, I., "Investigations of the Lower Ordovician of the Siljan Dist., Sweden II. Lower Ordovician penetrative and enveloping algæ from the Siljan Dist.," *Uppsala Univ. Geol. Inst. Bull.*, 1949, **33**, 409.
2. Hornibrook, N. de B., *A Handbook of New Zealand Microfossils*, Inst. Ser. Dep. Scient. Int. Res., New Zealand, 1968, **62**, 136.
3. Nadson, G., "Le algus perforantes leur distribution er leur role dans la nature acad," *Sci. Comptes Rendus*, 1927, **84**, 1015.
4. Neumann Madelaine, *Manuel De Micro-palæontologic des Foraminiferes (systematique-stratigraphic)*, Gauthiers-Villars, Paris, 1967, p. 297.
5. Rao, C. Gundu, "Sedimentology of the reef carbonates at the base of Trichinopoly Upper Cretaceous, S. India," *Jour. Geol. Soc. India*, 1969 (In press).
6. Wolf, K. H., "Petrogenesis and palæoenvironment, of devonian algal limestones of New-South Wales," *Sedimentology*, 1965, **4**, 113.
7. Swinchatt, J. P., "Algal boring; a possible depth indicator in carbonate rocks and sediments," *Geol. Soc. Amer. Bull.*, 1969, p. 1391.

OCCURRENCE OF PSEUDOLYCORINE IN THE BULBS OF *VALLOTA SPECIOSA*

THE chemical examination of the fresh bulbs of *Vallota speciosa*, a member of the plant family, Amaryllidaceæ, is described here. The plant growing as an ornamental garden plant in and around the Andhra University Campus, Waltair, has been collected and examined.

The minced fresh bulbs (3 Kg.) were completely extracted with alcohol (3 to 41) and the total alcoholic extract was concentrated to a small bulk and was suspended in water. The aqueous suspension was adjusted to pH 6 and extracted with ether followed by chloroform. The residues from these extracts were discarded since they did not give any crystalline material. The aqueous suspension was then made alkaline (pH 8) and again extracted with chloroform and chloroform-alcohol (2 : 1). The solvents from these extracts were removed under reduced pressure and the residue gave a crystalline substance, m.p. 230–32° (d). The mother liquors did not give any further crop of crystalline material even after chromatography.

The crystalline substance obtained above was recrystallised twice from methanol when stout prisms were obtained, m.p. 242–45° (d). $[\alpha]_D^{28} = -61° \pm 2°$ (methanol). The compound answered all tests for alkaloids and did not contain a methylene dioxy group and analysed for $C_{16}H_{19}NO_4$. The acetate was prepared by the usual method with pyridine and acetic anhydride and was crystallised from methanol-ether when refracting stout needles were obtained, m.p. 202–204°. $[\alpha]_D^{28} = +38{\cdot}0 \pm 2°$ (chloroform) and analysis agreed for the formula $C_{22}H_{25}NO_7$. The methyl ether of the original compound was prepared with diazomethane; the product crystallised from methanol as prisms, m.p. 235–38° (d). $[\alpha]_D^{28} = -51 \pm 2°$ (methanol) analysing for the formula $C_{17}H_{21}NO_4$.

The above properties of the original compound and its derivatives are in good agreement with those reported for pseudolycorine, its triacetate and methylether.[1] The identity of the compound as pseudolycorine was established by T.L.C., mass spectrum and N.M.R. data by Prof. W. C. Wildman, Iowa University, U.S.A., to whom we are grateful.

Pseudolycorine was not reported from *Vallota purpurea* a species examined earlier.[2]

We are further grateful to the Director, Royal Botanical Gardens, Kew, England, for the identification of the plant material.

Pharmaceutical Labs., R. V. Krishna Rao.
Andhra University, (Mrs.) R. Vimala Devi.
Waltair, *February* 3, 1970.

---

1. Uyeo, S. and Yanaihara, N., *J. Chem. Soc.*, **1959**, p. 172.
2. Boit, H. G., *Chem. Ber.*, **1956**, **89**, 1129.

A NOTE ON *DIADEGMA VARUNA* GUPTA (HYMENOPTERA: ICHNEUMONIDAE), A PARASITE OF *PLUTELLA XYLOSTELLA* (LINNAEUS) (LEPIDOPTERA: PLUTELLIDAE) AT KALIMPONG (WEST BENGAL)

The diamond back moth, *Plutella xylostella* (Linnaeus) (= *maculipennis* Curtis) (Lepidoptera: Plutellidae) is a major pest of Crucifers all over the world. The damage is especially serious when young plants are infested. The pest has many recorded parasites in various parts of the world. From India, thirteen hymenopterous parasites have so far been reported. These are: *Brachymeria excarinata* Gahan (Chalcididæ) and *Tetrastichus sokolowskii* Kurdj. (Eulophidæ) recorded by Cherian and Basheer (1938, 1939); *Brachymeria plutellophaga* Girault by Mani (1940); *Angitia fenestralis* (Hlg.) and *Thyrœella collaris* Grav. (Ichneumanidæ) (Dutt, 1923); *Voria ruralis* Fall. (Tachinidæ) and *Horogenes* sp. (Ichneumonidæ) by Simmonds and Rao (1960); *Apanteles* sp. (*glomeratus* gr.), *A. plutellæ* Kurdj. and *Chelonus* (*Microchelonus*) sp. *versatilis* Wilk. (Braconidæ), *Brachymeria* sp., *Hockeria testaceitarsis* Cam. and *Euchalcidia* sp. (Chalcidæ) by Patel and Patel (1968) and *Macromalon orientale* Kerrich (Braconidæ) by Chacko (1968).

In the course of search for parasites of *P. xylostella* for supply to Hong Kong for trial against the pest in that country, the author came across a hitherto unrecorded larval-prepupal parasite at Kalimpong (Dist.: Darjeeling) in West Bengal, which is being described by Dr. V. K. Gupta, Delhi University, Delhi, as *Diadegma varuna* (Hymenoptera: Ichneumonidæ). The species was reared only during March–April when the temperature in the fields ranged from 52 to 80° F. This species was responsible for 1·5% parasitism of a total of 15·5% larval and pupal parasitism of *P. xylostella* in the first week of April. The major parasites of this pest in the area were *M. orientale* and *T. collaris*. The observations carried out on *D. varuna* in the laboratory at temperatures ranging from 60 to 88° F. and humidity from 74 to 91 are described below.

The adult emerges by chewing out a circular cap at the anterior end of its papery brown cocoon. Females are sexually receptive at the time of emergence, whereas males usually become so 2–3 days after emergence. When a tube containing adult parasites is shaken, the males violently grab the females and copulate. Mating usually lasted from 5 minutes to an hour and a half, but in several cases the pairs, which remain motionless, almost feigning death, remained in copula for even longer. Females as well as males are multinuptial. One male mated with 8 females over a period of 6 days. The female is capable of oviposition from soon after emergence upto 30 days.

To breed the parasite, females kept in 3″ × 1″ glass tubes were offered naked host larvæ individually on a brush for oviposition. Though any stage of the host larva is accepted for egg deposition, third instar to mature larvæ are preferred. The female locates its host in the course of its random movements, even when host larvæ are offered on the host plants. Without holding the host it firmly pricks the host and oviposits.

The egg, larval and pupal periods occupied 4, 8–9 and 5–6 days, respectively. When the host larva forms its cocoon preparatory to pupation, the parasite larva has completed feeding and emerges from the host body and spins its cocoon. Fecundity of 2 females reared from field-collected material was 191 and 221. These females lived for nearly a month. On the other hand the average fecundity of 2 females of the F_2 generation reared in the laboratory was only 48. Longevity of 15 field-collected and 6 laboratory-reared F_1 females, studied by holding them individually in 3″ × 1″ glass tubes and feeding them 40% honey solution, varied from 14 to 42 days with an average of 18 days. Laboratory-reared males survived for 20–22 days. Females were preponderant.

These observations indicated that under successive laboratory rearings *D. varuna* loses its vitality and possibly the parasite has some natural source of food which possibly helps to maintain its vigour in the field.

Since parasitism is relatively very low, it is likely that *D. varuna* has other preferred hosts and that *P. xylostella* is only an occasional host. Further investigations are, however, warranted.

The author is grateful to Dr. V. P. Rao, CIBC, Indian Station, for his encouragement in this work and to the Director, British Museum, London, for identifying the parasite.

Commonwealth Institute of Biological Control,
Indian Station,
Bellary Road, Hebbal P.O.,
Bangalore-6, *February* 12, 1970.
V. R. PHALAK.*

---

*Present address: M.J. College, Jalgaon, Maharashtra.

1. Chacko, M. J., *Tech. Bull. Commonw. Inst. biol. Control*, 1968, **10**, 97.
2. Cherian, M. C. and Basheer, M., *Proc. Ind. Acad. Sci.*, 1938, **7 B** (6), 289.
3. — and —, *Ibid.*, 1939, **9 B** (2), 87.
4. Dutt, G. R., *Mem. Dept. Agric. India Ent. Ser.*, **8**, 21.
5. Mani, M. S., *I.C.A.R. Misc. Bull.*, 1940, **30**, 4.
6. Patel, V. C. and Patel, H. K., *Indian J. Ent.*, 1968, **30** (1), 86.
7. Simmonds, F. J. and Rao, V. P., *Can. Ent.*, 1960, **92**, 278.

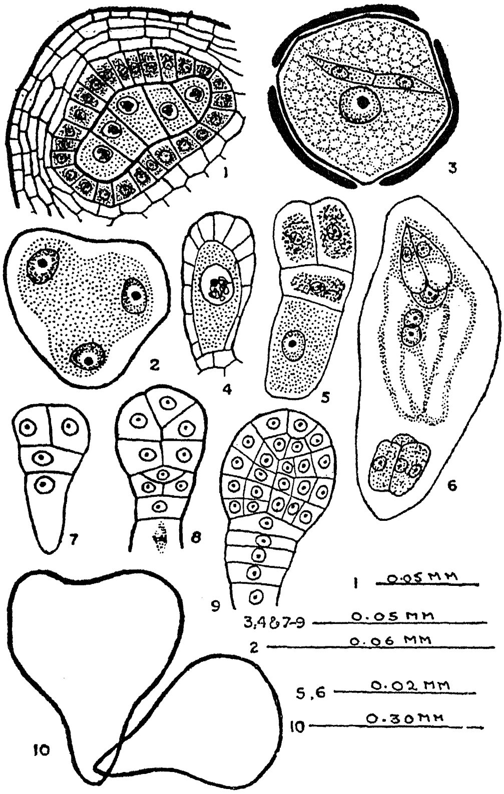
EMBRYOLOGY OF *RAUVOLFIA SERPENTINA* AND *CATHARANTHUS ROSEUS*

MEMBERS of Apocynaceæ like *Rauvolfia*, *Catharanthus* (= *Vinca*), *Thevetia*, *Holarrhena*, etc., are some of the important medicinal plants of India. *Rauvolfia serpentina* is a widely known plant used for the treatment of blood pressure. *Catharanthus roseus* (= *Vinca rosea*), with its beautiful purple flowers, grows as a common weed, and has become of interest to pharmacologists. The roots and leaves are rich in the alkaloid azmaline, and are used not only in the treatment of blood pressure but also for curing leukemia because of their antitumor properties.

This report deals with the embryology of *Rauvolfia serpentina* Benth. and *Catharanthus roseus* (L.) G. Don (= *Vinca rosea*).

The structure of the anther shows the epidermis, fibrous endothecium, 2–4 wall layers and tapetum surrounding the sporogenous tissue. The tapetum is of secretory type (Fig. 1). The pollen mother cells divide simultaneously to produce tetrahedral and bilateral tetrads (Fig. 2). Cytokinesis is by furrowing. Mature pollen grains are 3-celled and triporate (Fig. 3).

The ovary is superior, bicarpellary and bilocular with many unitegmic and tenuinucellate ovules. It is anatropous in *Rauvolfia* and hemianatropous in *Catharanthus*. The hypodermal archesporial cell develops directly into the megaspore mother cell which undergoes the two meiotic divisions producing both linear and T-shaped tetrads in *Catharanthus* and only linear tetrads in *Rauvolfia*. The chalazal megaspore develops into an eight-nucleate embryo-sac according to the Polygonum type (Figs. 4–6).



FIGS. 1–10. Figs. 1–9. *Catharanthus roseus*. Fig. 10. *Rauvolfia serpentina*. Fig. 1. T.S. anther lobe showing pollen mother cells in meiotic prophase 1. Fig. 2. Pollen tetrad showing cytokinesis by furrowing. Fig. 3. Three-celled pollen grain. Figs. 4–6. Various stages in the development of the embryo-sac. Figs. 7–9. Various stages in the development of the embryo. Fig. 10. Polyembryony.

Fertilization is porogamous. Triple fusion takes place earlier than syngamy. Endosperm development is of the nuclear type. Later on it becomes cellular.

In *Catharanthus roseus* the zygote divides transversely and the terminal cell *ca* of the two-celled proembryo contributes to the formation of the embryo proper—epiphysis, cotyledons and hypocotyledonary region. The basal cell *cb* contributes to the suspensor and hypophyseal region. Thus the embryo development conforms to the Trifolium variation of Onagrad type (Figs. 7–9).

Though a hundred fertilised ovules in different developmental stages were observed in *Rauvolfia serpentina*, only very few cases with the embryo development were noticed and it could not be assigned to any particular type. In a few cases of *Rauvolfia serpentina*, however, polyembryony could be observed. The second embryo by its position suggests its origin from one of the synergids (Fig. 10).

It is observed that in *Rauvolfia serpentina*, the percentage of seed-setting is very poor and propagation is mostly done by vegetative methods. In *Catharanthus roseus* on the other hand seed-setting is very high and almost all the ovules in the ovary are fertile and develop into seeds. In all other essential embryological features the two genera show great uniformity.

My sincere thanks are due to Prof. J. Venkateswarlu for his help and encouragement.

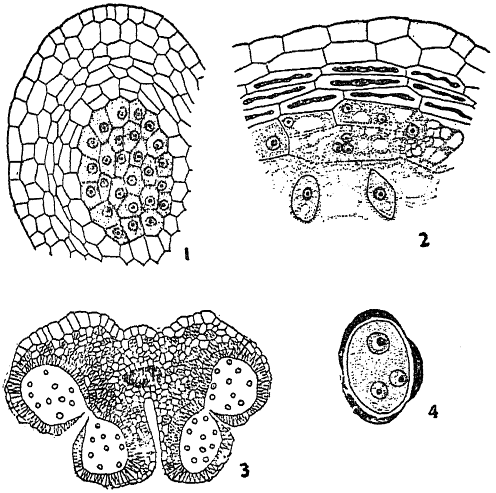
Dept. of Botany, H. MAHESWARI DEVI.
Andhra University,
Waltair, *September* 18, 1969.

TAPETAL DEGENERATION IN *CAPPARIS GRANDIS* LINN. F. SUPPL.

SOME interesting points regarding degeneration of tapetum during anther development were noticed in *Capparis grandis*. These are recorded here along with a short account of microsporogenesis and male gametophyte.

The male archesporium, arising hypodermally at the four corners of a young anther, consists of a plate of 3–5 cells extending over its entire length. It divides periclinally into the primary parietal and primary sporogenous layers. The former subsequently forms a 6–7-layered anther wall inclusive of the epidermis (Fig. 1). The epidermal layer persists at places consisting of highly stretched and tangentially flattened cells. It is interesting to note that the hypodermal layer develops into endothecium having lignified spiral bands in its cells unlike in usual cases where they form straight fibrous thickenings. Likewise, cells of connective 3–4 cells deep, also develop these spiral thickenings (Fig. 3). The three middle layers are short-lived. The degeneration in these layers commences in the layer immediately outside the tapetum as in *Capparis decidua* (Narayan[3]).

The tapetum is the innermost wall layer. It is biseriate at places (Fig. 2). Its cells are uninucleate when just formed but become multinucleate later (Fig. 2). Individual tapetal cells are very prominent and bigger than the sporogenous cells. These cells which are densely cytoplasmic later fall apart, become vacuolate and their inner tangential walls become perforated. As seen in section they present a beaded appearance (Fig. 2). The formation of the perforations is the most significant point in the behaviour of tapetum prior to degeneration in this species. During development the tapetum secretes a jelly-like substance which oozes out into the anther cavity. It takes a deep stain presenting a false appearance of a periplasmodium at this stage. It is further noted that wherever the tapetum is biseriate, the inner tangential walls of the outer cells too show these perforations (Fig. 2). It is very likely that these tapetal cells develop these perforations on all the walls thereby facilitating the flow of degenerating secretion products to nurture the developing pollen grains more efficiently. During this time the nuclei of tapetal cells degenerate *in situ*. Thus the tapetum is secretory in nature in this taxon. Such a mode of degeneration of tapetum is recently reported by Mukherjee[2] in *Acalypha ciliata* (*see also* Johri and Kapil[1]).



FIGS. 1–4. *Capparis grandis* Linn. F. Suppl. Fig. 1. Part of anther lobe showing wall layers. Fig. 2. T.S. anther lobe (part) showing wall layers and degeneration of tapetum. Fig. 3. T.S. anther (Diagrammatic). Fig. 4. Mature pollen grain. Figs. 1, 2, 4, × 250; Fig. 3, × 70.

The primary sporogenous cells divide many times. Meiosis in pollen mother cells is normal and cytokinesis is simultaneous resulting in tetrahedral arrangements of microspores. The nucleus of the young microspore divides to form a small generative and a big vegetative cell. The former later divides into two male gametes. Thus mature pollen grains in this taxon are 3-celled (Fig. 4) as in *Cratæva religiosa* (Raghavan[4]).

We are grateful to Prof. L. B. Kajale for kindly going through the manuscript and necessary facilities. The second author is also thankful to Dr. G. B. Deodikar, Director, M.A.C.S., Poona, for his kind interest.

Botany Department,
Nagpur University Campus,
Amravati Road, Nagpur-1,
January, 1, 1970.

M. D. PADHYE.
P. B. VAIDYA.

---

1. Johri, B. M. and Kapil, R. N., *Phytomorphology*, 1953, **3**, **137**.
2. Mukherjee, P. K., *Proc. Nat. Acad. Sci.*, 1964, **34 B**, 129.
3. Narayan, H. S., *Phytomorphology*, 1962, **12**, 167.
4. Raghavan, T. S., *Proc. Ind. Acad. Sci.*, 1941, **13 B**, 235.

A NEW SPECIES OF *PHYLLOSTICTA* PERS. EX DESM. FROM JODHPUR

DURING the study of sphæropsidales of Jodhpur, the author recorded a leaf-spot disease on *Pithecolobium dulce* Benth. The diseased and healthy portion was demarcated by dark brown boundaries. The disease first appeared as light brown spots on the tip which gradually advanced towards the base. At advanced stages the lesions became irregular and changed to brown colour. Black dot-like pycnidia were profusely produced in the infected regions. Examination of the lesion revealed the pathogen to be a *Phyllosticta*. The specimen was sent to C.M.I., Kew, where it was examined by Dr. Punithalingam but it could not be assigned to any specific position. The conidial and pycnidial morphology of the organism was compared with all the existing species of *Phyllosticta* but it did not tally with any of the present species.[1-4] It is, therefore, being designated as a new species, *i.e.*, *Phyllosticta pithecolobii*.

Phyllosticta pithecolobii SP. NOV.

Hyphæ colourless to light brown, closely septate, poorly branched, 1·5–3·6 μ wide; pycnidia globose to elongate, assuming balloon-shaped structure, light yellow to yellowish-brown, erumpent, 33·6–168·4 μ in diameter (average 142·8 μ), wall persistent, membranous, few-layered; conidia borne singly at the tips of short conidiophores, hyaline to light yellowish-green, single-celled, wall irregular, 7·6–9·8 × 3·8–5·4 μ (average 8·6 × 4·2 μ).

Culture deposited in C.M.I., Kew, Herb. No. 130815.

Latin Diagnosis.—Hyphæ hyalinæ vel pallide brunneæ, frequenter septatæ, sparse ramosæ, 1·5–3·6 μ latæ; pycnidia globosa vel elongata, demum physalidiformia, pallide lutea vel luteo-brunnea, erumpentia, 33·6–168·4 μ (media 142·8 μ) diametro, pariete persistente, membranaceo, *e* laminis paucis composito; conidia singula in apicibus conidiophororum brevium orta, hyalina vel pallide luteo-viridia, haud septata, tunica irregulari, 7·6–9·8 × 3·8–5·4 μ (media 8·6 × 4·2 μ).

Cultura in Instituto Respublicæ Mycologico (C.M.I.) Kewensi sub numero 130815 deposita.

The author expresses his grateful thanks to Dr. K. S. Bilgrami for his guidance, to Dr. G. C. Ainsworth and Dr. Punithalingam of C.M.I., Kew, England, for help in the identification of species. He is also thankful to Dr. Donald P. Rogers, University of Illinois, U.S.A., for Latin diagnosis.

Botany Department,
University of Jodhpur,
Jodhpur, *January* 19, 1970.

J. L. SHREEMALI

---

1. Saccardo, P. A., *Sylloge Fungorum*.
2. Butler, E. J. and Bisby, G. R., *The Fungi of India*, Indian Council of Agri. Res., New Delhi, India, 1960.
3. Tandon, R. N. and Chandra, S., Botany Section, Supplment to the *List of Indian Fungi*, 1962.
4. Vasudeva, R. S., *Fungi of India*, Supplement-I, Indian Council of Agri. Res., New Delhi, India, 1962.

VIABILITY TESTS ON JUTE SEEDS (*CORCHORUS OLITORIUS* L. VAR. JRO 632)

JUTE seeds are very delicate and lose viability within a short span of 4–6 months under poor conditions of storage.[1] The importance of proper storage is thus obvious. The viability of seeds can be worked out with fair accuracy by germination test conducted on moistened blotting-paper but this method requires 24–72 hours with jute seeds. Cottrell[2,3] tested cereal seeds through use of 2-3-5 triphenyl tetra-

TABLE I

Test	Seed category	Colour		Fluorescence
		Extract in test-tube	Spot on filter-paper	
1. Aqueous extract ..	Viable	Colourless to tinged yellow, clear	Colourless	Nil
..	Non-viable	Pale yellow to yellowish-orange, frequently turbid	Faint yellow	Marked
2. Alcohol-benzene extract ..	Viable	Greenish-yellow	Greenish yellow	Some
	Non-viable	Deep yellow	Deep yellow	Marked
3. Crushing ..	Viable	..	Yellow	Faint
	Non-viable	..	Yellowish orange	Marked

zolium chloride and evaluated their germination capacity in less than 24 hours. Mukherjee et al.[4] employed triphenyl tetrazolium bromide on cut seeds of *Corchorus capsularis*. The development of a purple-red colour on the cut surfaces of seeds was considered to be an indication of normal viability. However, jute seeds are very small and cutting of seeds and estimation of colour differences on cut surfaces is a laborious task. It was, therefore, felt necessary to work out procedures for determining the viability of jute seeds which would be rapid, reliable and sufficiently simple to hold promise of eventual implementation by the farmer.

Three different methods have been tested in our laboratory for determining the viability of jute seeds (*Corchorus olitorius* L. var JRO 632). Seeds recording more than 90% germination in the petri dishes were considered viable and seeds with nil germination as non-viable. For test No. 1 (Table I) seeds were soaked in excess water for 3-4 hours and the supernatant liquid was used. For test No. 2, seeds were extracted in alcohol-benzene mixture (1 : 2) in a soxhlet apparatus and the extract was boiled off, the residue was dissolved in benzene and the resulting solution was used. For test No. 3, moistened seeds were directly crushed on the filter-paper and the spots left behind were examined. Filter-paper spots from all three tests were studied under the UV (253-366 mμ) lamp. The colour description of the extracts in test tubes and spots on filter-paper and presence, if any, of fluorescence under the UV lamp are shown in Table I.

One-, two- and three-year old seeds of JRO 632 (*C. olitorius*) showing 96, 92 and 0·00% germination respectively were also tested. Turbidity and more discernible colourations of solutions of extracts appear to be associated with lack of viability and not with the age of the seed. Further support to this view was obtained when fresh samples of viable seeds were steamed for 30 minutes and aqueous extracts of unsteamed (viable) and steamed (non-viable) seeds were compared; it was noticed that intense colouration and frequent turbidity were restricted to extracts of steamed seeds.

The seed-crushing test gives marked colour difference even under normal light, and is the quickest and simplest of the three. It is, therefore, felt that this can be used for ready identification of viable and non-viable seeds at the field level. The aqueous extract test is also simple and decisive.

Work is in progress to evaluate the power of resolution of the tests in mixtures of viable and non-viable seeds.

We thank the Director, Indian Jute Industries' Research Association, for permission to publish the results described here and Mr. A. K. Datta for occasional help.

Indian Jute Industries' J. P. BHATTACHARYYA.
Research Association, M. S. SARMA.
Calcutta-53, *April* 23, 1970.

---

1. Kundu, B. C. and Sarma, M. S., *Agric. Res. Bull.*, ICJC, Calcutta, 1955, No. 3.
2. Cottrell, H. J., *Nature*, **1947**, **159**, **748**.
3. —, *Ann. Appl. Biol.*, **1948**, **35**, **123**.
4. Mukherjee, N., Ghosh T. and Jacob, K. T., *Jute Bulletin* **1962**, **25**, **89**.

tetrahedral arrangements of microspores. The nucleus of the young microspore divides to form a small generative and a big vegetative cell. The former later divides into two male gametes. Thus mature pollen grains in this taxon are 3-celled (Fig. 4) as in *Cratæva religiosa* (Raghavan[4]).

We are grateful to Prof. L. B. Kajale for kindly going through the manuscript and necessary facilities. The second author is also thankful to Dr. G. B. Deodikar, Director, M.A.C.S., Poona, for his kind interest.

Botany Department, M. D. PADHYE.
Nagpur University Campus, P. B. VAIDYA.
Amravati Road, Nagpur-1,
January, 1, 1970.

---

1. Johri, B. M. and Kapil, R. N., *Phytomorphology*, 1953, **3, 137.**
2. Mukherjee, P. K., *Proc. Nat. Acad. Sci.*, 1964, **34 B,** 129.
3. Narayan, H. S., *Phytomorphology*, 1962, **12,** 107.
4. Raghavan, T. S., *Proc. Ind. Acad. Sci.*, 1941, **13 B,** 235.

A NEW SPECIES OF *PHYLLOSTICTA* PERS. EX DESM. FROM JODHPUR

DURING the study of sphæropsidales of Jodhpur, the author recorded a leaf-spot disease on *Pithecolobium dulce* Benth. The diseased and healthy portion was demarcated by dark brown boundaries. The disease first appeared as light brown spots on the tip which gradually advanced towards the base. At advanced stages the lesions became irregular and changed to brown colour. Black dot-like pycnidia were profusely produced in the infected regions. Examination of the lesion revealed the pathogen to be a *Phyllosticta*. The specimen was sent to C.M.I., Kew, where it was examined by Dr. Punithalingam but it could not be assigned to any specific position. The conidial and pycnidial morphology of the organism was compared with all the existing species of *Phyllosticta* but it did not tally with any of the present species.[1-4] It is, therefore, being designated as a new species, *i.e., Phyllosticta pithecolobii.*

Phyllosticta pithecolobii SP. NOV.

Hyphæ colourless to light brown, closely septate, poorly branched, 1·5–3·6 μ wide; pycnidia globose to elongate, assuming balloon-shaped structure, light yellow to yellowish-brown, erumpent, 33·6–168·4 μ in diameter (average 142·8 μ), wall persistent, membranous, few-layered; conidia borne singly at the tips of short conidiophores, hyaline to light yellowish-green, single-celled, wall irregular, 7·6–9·8 × 3·8–5·4 μ (average 8·6 × 4·2 μ).

Culture deposited in C.M.I., Kew, Herb. No. 130815.

Latin Diagnosis.—Hyphæ hyalinæ vel pallide brunneæ, frequenter septatæ, sparse ramosæ, 1·5–3·6 μ latæ; pycnidia globosa vel elongata, demum physalidiformia, pallide lutea vel luteo-brunnea, erumpentia, 33·6–168·4 μ (media 142·8 μ) diametro, pariete persistente, membranaceo, *e* laminis paucis composito; conidia singula in apicibus conidiophororum brevium orta, hyalina vel pallide luteo-viridia, haud septata, tunica irregulari, 7·6–9·8 × 3·8–5·4 μ (media 8·6 × 4·2 μ).

Cultura in Instituto Respublicæ Mycologico (C.M.I.) Kewensi sub numero 130815 deposita.

The author expresses his grateful thanks to Dr. K. S. Bilgrami for his guidance, to Dr. G. C. Ainsworth and Dr. Punithalingam of C.M.I., Kew, England, for help in the identification of species. He is also thankful to Dr. Donald P. Rogers, University of Illinois, U.S.A., for Latin diagnosis.

Botany Department, J. L. SHREEMALI
University of Jodhpur,
Jodhpur, *January* 19, 1970.

---

1. Saccardo, P. A., *Sylloge Fungorum.*
2. Butler, E. J. and Bisby, G. R., *The Fungi of India*, Indian Council of Agri. Res., New Delhi, India, 1960.
3. Tandon, R. N. and Chandra, S., Botany Section, Supplment to the *List of Indian Fungi*, 1962.
4. Vasudeva, R. S., *Fungi of India*, Supplement–I, Indian Council of Agri. Res., New Delhi, India, 1962.

VIABILITY TESTS ON JUTE SEEDS (*CORCHORUS OLITORIUS* L. VAR. JRO 632)

JUTE seeds are very delicate and lose viability within a short span of 4–6 months under poor conditions of storage.[1] The importance of proper storage is thus obvious. The viability of seeds can be worked out with fair accuracy by germination test conducted on moistened blotting-paper but this method requires 24–72 hours with jute seeds. Cottrell[2,3] tested cereal seeds through use of 2-3-5 triphenyl tetra-

TABLE I

Test		Seed category	Colour		Fluorescence
			Extract in test-tube	Spot on filter-paper	
1. Aqueous extract	..	Viable	Colourless to tinged yellow, clear	Colourless	Nil
	..	Non-viable	Pale yellow to yellowish-orange, frequently turbid	Faint yellow	Marked
2. Alcohol-benzene extract	..	Viable	Greenish-yellow	Greenish-yellow	Some
		Non-viable	Deep yellow	Deep yellow	Marked
3. Crushing	..	Viable	..	Yellow	Faint
		Non-viable	..	Yellowish orange	Marked

zolium chloride and evaluated their germination capacity in less than 24 hours. Mukherjee *et al.*[4] employed triphenyl tetrazolium bromide on cut seeds of *Corchorus capsularis*. The development of a purplish-red colour on the cut surfaces of seeds was considered to be an indication of normal viability. However, jute seeds are very small and cutting of seeds and estimation of colour differences on cut surfaces is a laborious task. It was, therefore, felt necessary to work out procedures for determining the viability of jute seeds which would be rapid, reliable and sufficiently simple to hold promise of eventual implementation by the farmer.

Three different methods have been tested in our laboratory for determining the viability of jute seeds (*Corchorus olitorius* L. var. JRO 632). Seeds recording more than 90% germination in the petri dishes were considered viable and seeds with nil germination as non-viable. For test No. 1 (Table I) seeds were soaked in excess water for 3–4 hours and the supernatant liquid was used. For test No. 2, seeds were extracted in alcohol-benzene mixture (1 : 2) in a soxhlet apparatus and the extract was boiled off, the residue was dissolved in benzene and the resulting solution was used. For test No. 3, moistened seeds were directly crushed on the filter-paper and the spots left behind were examined. Filter-paper spots from all three tests were studied under the UV (253–366 mμ) lamp. The colour description of the extracts in test-tubes and spots on filter-paper and presence, if any, of fluorescence under the UV lamp are shown in Table I.

One-, two- and three-year old seeds of JRO 632 (*C. olitorius*) showing 96, 92 and 0·00% germination respectively were also tested. Turbidity and more discernible colourations of solutions of extracts appear to be associated with lack of viability and not with the age of the seed. Further support to this view was obtained when fresh samples of viable seeds were steamed for 30 minutes and aqueous extracts of unsteamed (viable) and steamed (non-viable) seeds were compared; it was noticed that intense colouration and frequent turbidity were restricted to extracts of steamed seeds.

The seed-crushing test gives marked colour difference even under normal light, and is the quickest and simplest of the three. It is, therefore, felt that this can be used for ready identification of viable and non-viable seeds at the field level. The aqueous extract test is also simple and decisive.

Work is in progress to evaluate the power of resolution of the tests in mixtures of viable and non-viable seeds.

We thank the Director, Indian Jute Industries' Research Association, for permission to publish the results described here and Mr. A. K. Datta for occasional help.

Indian Jute Industries' J. P. BHATTACHARYYA.
Research Association, M. S. SARMA.
Calcutta-53, *April* 23, 1970.

---

1. Kundu, B. C. and Sarma, M. S., *Agric. Res. Bull.*, ICJC, Calcutta, 1955, No. 3.
2. Cottrell, H. J., *Nature*, 1947, **159**, 748.
3. —, *Ann. Appl. Biol.*, 1948, **35**, 123.
4. Mukherjee, N., Ghosh, T. and Jacob, K. T., *Jute Bulletin* 1962, **25**, 89.

REVIEWS AND NOTICES OF BOOKS

Aircraft Vibration and Flutter. By Robert H. Scanlan and Robert Rosenbaum. (Dover Publications, Inc., New York), 1969. Pp. xii + 428. Price $ 3.53.

This introductory text contains the basic and elementary material and general methods of approach to problems of aircraft vibration and flutter. It was written by a professor of civil engineering at Princeton University (Robert Scanlan) and by a practising engineer with the Federal Aviation Administration (Mr. Rosenbaum) for a double audience: engineers who are not thoroughly familiar with modern techniques of aircraft dynamics, and senior or graduate students of aeronautic design.

The self-contained text is written from an engineering approach. The first six chapters (basic mathematical techniques, the Lagrangean equations of motion and vibration theory, the linear single-degree-of-freedom system, the two-degree-of-freedom system, self-excited systems, basic beam structural relationships) provide the foundation upon which the rest of the text is built. Successive chapters cover uncoupled beam vibration, two- and three-dimensional flutter theory, empennage vibration and flutter analysis, normal (coupled) modes of vibration, flutter analyses, using normal (coupled) modes, solution of the flutter stability determinant, wing torsional divergence, instrumentation and testing, and vibration and flutter of swept wings.

Advanced material on subsonic and supersonic flow is covered in an appendix. A 21-page bibliography, 11 fully-worked examples, and 56 problems to be solved supplement the text.

C. V. R.

Concepts and Development of Quantum Physics. By John C. Slater. (Dover Publications, Inc., 180, Varick Street, New York), 1969. Pp. xi + 322. Price $ 3.00.

This Dover edition, first published in 1969, is an unabridged and slightly corrected reprint of the work originally published in 1955 by the McGraw-Hill Book Company, Inc., under the title *Modern Physics*.

In this book the author presents historically the development of the ideas which contribute to the current understanding of atomic and molecular physics, and particularly of quantum mechanics. The text consistently stresses the descriptive rather than the theoretical, and for this reason it will be useful to a wide audience.

The titles of the chapters dealt with in this book are: 1. The Atom in Nineteenth-Century Physics; 2. The Electron Theory and Relativity; 3. Beginning of the Quantum Theory; 4. The Nuclear Atom; 5. The Bohr Atom; 6. X-Rays and Crystal Structure; 7. Atomic Spectra and the Periodic System of the Elements; 8. Complex Spectra and Molecular Spectra; 9. Wave Mechanics; 10. Atoms, Molecules, and Solids; and 11. Nuclear Physics and High-Energy Particles.

This book will be as fascinating to the physicist, who is not accustomed to reading of modern physics in the lucid, coherent and historical way in which it is presented here, as it will be useful to the layman who desires an understanding of the essential developments of modern atomic physics.

C. V. R.

Solute-Solvent Interaction. Edited by J. F. Coetzee and Calvin D. Ritchie. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xiv + 653. Price $ 29.50 or £ 14 0 *sh.* 0 *d.*

Since the majority of reactions that are of chemical or biological interest occur in solution, solute-solvent interactions are currently being explored in all branches of chemistry and other disciplines as well. With the rapid accumulation of fundamental information on non-aqueous solutions and the new perspectives on the complex problem of aqueous solutions, the need for a book covering these areas has been created. *Solute-Solvent Interactions* concentrates on topics of wide interest. It acquaints the reader with the advances that have been made in understanding solvent effects in several representative areas. The first chapter, "Heats and Entropies of Ionization", contains a critical compilation and discussion of data on the ionization of Bronsted acids in aqueous solution; "Medium Effects and pH in Non-aqueous Solvents" covers the basic concepts and techniques for the study of non-aqueous systems. These two chapters serve as an introduction to the remaining ones which include such topics as: Interactions in dipolar aprotic solvents, solvent isotope effects in equilibria and kinetics, and organoalkali compounds in ether. Each article is written by a specialist and is indispensable to advanced students and to many investigators in all branches of chemistry. C. V. R.

Flame Emission and Atomic Absorption Spectrometry (Vol. 1)—*Theory.* Edited by John A. Dean and Theodore C. Rains. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xiv + 436. Price $ 21.75.

In three volumes, the editors are bringing together the various aspects of flame emission, atomic-absorption and atomic-fluorescence spectrometric methods. They will provide a source of theoretical and practical analytical information for all inquisitive persons who are either engaged in or considering the use of these flame spectrometric methods. The chapters are written by authorities from all over the world.

Volume 1, *Theory,* under review is devoted to the theoretical aspects of the several flame methods. It commences with a general historical survey and intercomparison of methods. The contributors discuss excitation mechanisms, flames, flame emission spectra, species in existence in flame gases, interferences of all types, accuracy and precision, and interrelationships among operational parameters and spectral features. From these chapters the reader will achieve a better understanding of the numerous problems facing a flame photometrist.

Volume 2 will consider instrumentation and operational techniques. Volume 3 will be devoted to the consideration of the individual elements that either can be excited to emit radiation in a flame, or that in their atomic state can absorb radiation transmitted through the flame gases. C. V. R.

Physical Methods in Macromolecular Chemistry (Vol. 1). Edited by Benjamin Carroll. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. x + 385. Price $ 17.75.

The continuing rapid expansion of research in the macromolecular sciences has brought along with it the inevitable "information explosion" particular to the field, compounding the difficulties of scientists keeping up with new developments in macromolecular chemistry. This series gives the research worker a convenient and up-to-date key to physical and physicochemical methods of particular significance. It is the first series to correlate information on physical methods in macromolecular chemistry that was previously scattered throughout the literature. *Physical Methods in Macromolecular Chemistry* will provide the scientist with the understanding needed to select the most useful method for his research problem. By focusing on the interpretation of experimental data, the contributors point out important features and principal limitations of the methods treated. Both synthetic and naturally occurring macromolecules are considered.

The authors, all workers actively engaged in research, suggest new directions in the use of the techniques and also give hints of new horizons in the development of the methods themselves. Both new and routine applications of the various methods are covered. Instrumentation is emphasized for novel methods and those insufficiently covered in the literature.

Among the new areas covered in this first volume are the molecular weight distribution of insoluble polymers, internal reflection, spectroscopy of polymers, and fluorescence techniques for polymer solutions. Of considerable interest are the chapters dealing with radiation effects in polymers and the electric properties of synthetic polymers. Surface chemistry methods for polymers are considered in depth. C. V. R.

Review of Physics in Technology. (Published by the Institute of Physics and the Physical Society, 1, Lowther Gardens, Prince Consort Road, London S.W. 7), Three issues a year. Annual subscription for 1970 is £ 3 or $ 7.20.

This new journal being brought out by the Institute of Physics and the Physical Society is intended to meet the needs of the Physicist in the industrial environment, who is concerned primarily with the applications of physics in the field of technology. The style and content of the journal will be such as to attract individual subscribers. Thus the journal will be issued three times a year, and each issue will contain three or four review articles written by experts but in such a way as to be understood by physicists who are not specialists in the particular subject covered.

The issue under review, Vol. I, No. 1, is of 62 pages and contains the following articles: ESRO and its programme, by H. Bondi and J. Ortner; Molecular Engineering in the design of microwave ferrimagnetic garnets, by A. S. Hudson; Recent developments in conventional soft magnetic materials, by J. E. Thompson; and Back to the old trend, by C. L. Boltz.

This last article reviews the arguments and background to the British Governments leaflet: "Industrial Research and Development in Government Laboratories", otherwise known as the Green Paper. A. S. G.

The Indian Ephemeris and Nautical Almanac for the Year 1971. (Published by the Manager of Publications, Civil Lines, Delhi-6), Pp. xxii + 467. Price: Inland Rs. 17·00. Foreign: 39 *sh.* 8 *d.* or $6.12.

The present volume is the fourteenth in this series of annual publications by the Nautical Almanac Unit of the India Meteorological Department and contains all the necessary astronomical data for the year 1971. The Indian calendar data are extended upto March 20, 1972 to cover the Saka year 1893 of the Indian National Calendar.

The latest corrections of the primary constants of astronomy as adopted and recommended by the 1964 meeting of the International Astronomical Union (I.A.U.) and their implications are given as a special appendix pp. vi-ix, after the Preface. The Indian Ephemeris has been attempting to revise the data in the light of these corrections, from 1968 onwards, and the present volume has made a further step forward in this direction. A. S. G.

ANNOUNCEMENTS

The Indian Botanical Society

The Golden Jubilee of the Indian Botanical Society will be celebrated in the Department of Botany, Delhi University, from 23rd to 26th December, 1970 under the Presidentship of Dr. B. P. Pal, Director-General, I.C.A.R. Prof. P. Parija, a founder-member of the IBS, will inaugurate the session. There will be several academic programmes including two international symposia. Further information can be had from Prof. R. P. Roy, Honorary Secretary, Department of Botany, Patna University, Patna-5.

Symposium on Radiation and Radioisotopes in Soil Studies and Plant Nutrition

The Symposium on "Radiation and Radioisotopes in Soil Studies and Plant Nutrition" organised by the Food and Agriculture Committee of the Department of Atomic Energy will be held at the University of Agricultural Sciences, Hebbal, Bangalore-24, during December 21 to 23, 1970. The last date for sending the abstracts for the contributed papers is September 30, 1970. The abstracts should be sent to Dr. K. B. Mistry, Biology Division, Bhabha Atomic Research Centre, Trombay, Bombay-85.

Award of Research Degrees

Andhra University has awarded the Ph.D. degree in Chemistry to Shri C. Radhakrishnamurty; Ph.D. degree in Botany to Kum. T. Kamala and Shri V. Seshavataram; Ph.D. degree in Zoology to Sri. P. V. Bhavanarayana.

Karnatak University, Dharwar, has awarded the Ph.D. degree in Geology to Shri S. G. Phene; Ph.D. degree in Botany to (Miss) G. P. Sathyavathi.

The M.S. University of Baroda has awarded the Ph.D. degree in Physics to Shri Ramesh Kamalashanker Shukla; Ph.D. degree in Chemistry to Shri Ramesh Chandra; Ph.D. degree in Botany to Shri P. I. Chaudhari and Shri S. N. Vajranabhaiah; Ph.D. degree in Zoology to Shri N. L. Naik; Ph.D. degree in Microbiology to Shri Kukatla Koteswara Rao.

The Osmania University has awarded the Ph.D. degree in Genetics to Smt. V. Vijaya Kumari.

ERRATUM

Current Science 1970, 39, August 5 issue, Pages 350 and 351 (Radioiodine Induced Thyroid Tumours). The legends under Figs. 1 and 2 should be interchanged, and thus read:

Fig. 1. Normal thyroid. Bourn's fluid. PAS-Hæmatoxylin, × 450.

Fig. 2. Cystic thyroid after one mCi I-131 treatment, × 450.

Books Received

Annual Review of Pharmacology (Vol. 10). (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, Calif. 94306), 1970. Pp. vii + 505. Price $8.50 in U.S.A. and $9.00 other countries.

Annual Review of Medicine (Vol. 21). (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, Calif. 94306), 1970. Pp. 501. Price $10.00.

Soils—Their Nature, Classes, Distribution, Uses and Care. By J. W. Batten and J. S. Gibson. (University of Alabama Press, University, Alabama), 1970. Pp. xii + 296. Price $7.00.

Planning and Planting Designs of Home Gardens. By B. L. Desai. (Indian Council of Agricultural Research, Krishi Bhawan, New Delhi-12), 1969. Pp. viii + 133. Price Rs. 5·00.

2173-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

CHARNOCKITE-PENINSULAR GNEISS RELATIONSHIP IN MYSORE STATE

C. S. PICHAMUTHU

Department of Mines and Geology, Bangalore-1

A PRECAMBRIAN problem somewhat similar to the Dharwar schist-Peninsular gneiss relationship (Pichamuthu, 1970, pp. 245–247) is that of the relationship of charnockite and Peninsular gneiss. The granulite facies rocks, to which charnockites belong, are products of high-grade, deep-seated regional metamorphism. According to some, the stratified structure of the crust probably reflects a succession of rocks in different stages of metamorphism. Belousov (1966, p. 294) has suggested that regional metamorphism which develops in geosynclines results in an overall division of the continental crust into two layers in addition to the sedimentary layer—a layer of granitisation and gneissification above (composed of metamorphic rocks of green schist and amphibolite facies, as well as granites of anatectic origin), and a layer of degranitisation below, the metamorphic rocks of the granulitic facies being regarded as the remnant of the degranitised initial material.

The increase in metamorphism of the Dharwars in Mysore State from north to south was first noticed by B. Rama Rao in 1936. The Dharwar region of southern Mysore has been folded into a large anticlinorium plunging north-north-west which, after erosion, has exposed gradually deeper levels of the crust as one proceeds southwards (Pichamuthu, 1951, pp. 117–119) and this is probably the reason for the progressive increase of metamorphism from north to south.

The effects of this increasing grade of metamorphism are noticeable not only in the Dharwars which comprise schists, limestones, quartzites, and ferruginous quartzites, but also in the gneisses, ultramafic rocks, and mafic dykes which are intrusive into the Dharwars. Mysore State can be divided broadly into zones characteristic of green schist facies, epidote-amphibolite facies, almandine-amphibolite facies, and granulite facies (Pichamuthu, 1953 *a*, pp. 1–3). It is probable, therefore, that the charnockitic region constitutes the lowest recognisable parts of the crust in South India as suggested independently by Radhakrishna (1964, p. 34) and Narayanaswamy (1964, p. 17). On the other hand, there are charnockites in Kerala, Madras, Andhra, and Mysore States which are intrusive into gneisses. Radiometric dating has also shown that in Peninsular India there are charnockites formed during different episodes of metamorphism with as wide a spacing of ages as 2740 m.y., 1500 m.y.—1300 m.y., and 550 m.y.

In many charnockite areas there are two contrasted types which can be recognised—one, which is granulitic or gneissic, frequently mylonitised, and another which is comparatively coarse-grained and granitic, the latter often exhibiting intrusive relationship with the former (Pichamuthu, 1953 *b*, p. 63; 1954, pp. 50–51). Recent work by Subramaniam (1959) has brought out the differences in the mineralogy of these rocks. The two kinds of charnockites were formed during different periods of metamorphism—the granulitic and gneissic charnockites originating by an earlier regional thermal metamorphism, and the coarse-grained granitic charnockites by later reactivation of the gneissic and charnockitic terrain. The granulitic type of charnockite probably belongs to the basement as suggested by T. V. Viswanathan (1969, p. 58), but there is no positive evidence in support of this view.

It is relevant in this context to refer to the age determinations made by Afanassyev *et al.* (1964, pp. 27–28) on a charnockite from Madras and of a dolerite dyke intruding it. The age of the charnockite is 1380–1400 m.y. whereas that of the intrusive dyke which has chilled edges is 1680 m.y. The radiometric age of the cross-cutting dolerite is thus older than that of the intruded charnockite by 300 m.y. According to Afanassyev *et al.*, this can only be explained if it is recognised that about 1400 m.y. ago, the charnockites and the dolerites cutting them were subject to feldspathisation, *i.e.*, potash metasomatism, and that while the charnockites experienced potash-feldspathisation, the dolerites on account of their lower capacity to mechanical fracturing and to metasomatic transformation in comparison with granitoid rocks, were only slightly affected by potash-feldspathisation. This supports the observation made in Mysore by the writer that the metamorphisms which gave rise to the two types of charnockite are demarcated by mafic dykes containing clouded feldspars (Pichamuthu, 1959 *a*, pp. 77–79).

Mafic xenoliths are present throughout in the Peninsular gneiss complex of Mysore State. The mineral composition of these xenoliths varies according to the metamorphic zone in which they occur. The xenoliths are chlorite schists in the green schist facies; hornblende schists, amphibolites, or hornblende granulites in the amphibolite facies; and pyroxene granulites in the granulite facies (Pichamuthu, 1965, p. 121). It is thus seen that in the granites and gneisses of Mysore State, the mafic inclusions vary in composition from chlorite schists to pyroxene granulites depending on the metamorphic setting in which they are found. Do all these xenoliths then belong to the basement? If not, why should only the ultrametamorphosed inclusions in the granulite facies be believed to be parts of the basement? The writer considers it more probable that these granulitic xenoliths are analogous to the so-called charnockite dykes which represent early mafic minor intrusions in the region and which now are often broken up into agmatites and transformed into pyroxene granulites (Pichamuthu, 1959 *b*, pp. 357–359).

Holland (1900, p. 225) has given examples of what he calls 'transgressive tongues of the charnockite series' protruding into the country rock (biotite gneiss), and running obliquely to the gneissic foliation. One such locality is a quarry about 5·5 km. south of Salem in Madras State where a fresh-looking charnockite intrudes a highly crushed and altered gneiss. This outcrop has been figured by Holland in his charnockite Memoir (Fig. 8 on p. 226), who has explained the occurrence as follows: 'When thin tongues of the two are so completely dove-tailed, it is difficult to see how the charnockite could escape the metamorphism which has been so evidently disastrous to the tongues of the gneiss. The most straightforward inference to be drawn is, it seems to me, that the charnockite attained its present position *after* the crushing of the gneiss, that, in fact, it has trespassed across the foliation planes of the latter. This implies that the charnockite has behaved after the fashion of an igneous rock, and that it is younger than the particular biotite-gneiss near Salem' (Holland, 1900, p. 226; 1901, p. 123).

Tongues of charnockite, which are not themselves foliated, frequently cross the foliation planes of the older gneiss in Wainad (Pascoe, 1950, p. 115). Krishnan (1968, p. 95) gives several examples of charnockites intruding the country in Salem, North Arcot, and Tirunelveli Districts in Madras State, and near Kondapalle (Krishna District), Polavaram (Godavari District), and other places in the Eastern Ghats.

In Mysore State the earlier geologists like Smeeth, Jayaram, Slater, and Sampat Iyengar were definitely of the opinion that the charnockites were intrusive into the Peninsular gneisses. In evaluating this intrusive relationship Rama Rao (1945, p. 5) in his monograph on the Charnockites of Mysore State made a distinction between the gneisses and granites, for he states that the 'exposures of massive norite, no doubt, indicate an intrusive relationship with its associated granitised biotite gneisses, but not with any true granites in the gneissic complex'.

Near Kabbal (about 65 km. S.S.W. of Bangalore) there is evidence that Peninsular gneiss has been transformed in parts into charnockite (Pichamuthu, 1960, pp. 135–136; 1961 *a*, pp. 46–49). The gneiss here is grey in colour, banded, and often contorted, while the charnockite patches in them are brownish-green, greasy looking, and coarse-grained with big hypersthene crystals. The disposition of the charnockite patches bears no relation to the foliation direction of the gneisses, sometimes running athwart it. Where recrystallisation has advanced, the gneissic foliation is destroyed, but in the intermediate stages the gneissic foliation can be traced through the patches getting charnockitised. Similar transformation of gneiss into charnockite has recently been recorded by Narasimha Rao (1969, p. 74) in parts of the Palni-Dindigal area of Madras State. Such instances indicate that charnockites in some regions of South India are subsequent in age to Peninsular gneiss.

It is interesting to note in this connection the gneiss-charnockite relationship in the Congo, Rwanda, and Burundi region of Africa. The mineralogical composition and age suggest that 'the Upper Luanyi Gneisses form the substratum from which the charnockites were derived by catazonal metamorphism' (Cahen and Lepersonne, 1967, p. 176). The metamorphic age of the Upper Luanyi Gneisses is 3280 m.y., and the age of charnockitisation about 2650 m.y. Similar transformation of gneiss into charnockite has also been recorded from Antarctica (McLeod, 1964, p. 240; Klimov, Ravich and Soloviev, 1964, pp. 455–456).

The largest area covered by charnockites in Mysore is in the elevated region of the Biligirirangan ranges in the extreme south of the

State. This is the northern extension of the charnockite massif of the Nilgiri mountains in Madras State. The regional strikes in these two regions offer a marked contrast. In southern Mysore the nearly N.-S. Dharwarian trend is almost abruptly terminated by the E.N.E.-W.S.W. Eastern Ghats trend, the junction being marked by mylonites and crushed gneisses (Pichamuthu, 1961 *b*, pp. 137–138; see Fig. 2). The Dharwarian N.-S. trend is prevalent in the charnockites occurring on the Biligirirangan Hills in Mysore State, whereas the charnockites in the Nilgiris have the E.N.E.-W.S.W. trend characteristic of the Eastern Ghats. In the same mass of charnockite, therefore, one part has Dharwarian strike and another the Eastern Ghats strike. One way of explaining this would probably be that charnockitisation affected this entire region but without materially disturbing the two distinct trends belonging to the older Dharwars and the younger rocks forming part of the Eastern Ghats belt.

Unfortunately, there are only a very few radiometric ages available for charnockites in Mysore State and they do not throw any decisive light on the relationship of these rocks to the gneisses. Sadashivaiah and Naganna (1964, p. 44) obtained a K-Ar, age of 2130 m.y. for the charnockite near Satnur (12° 27′ : 77° 19′) in Mysore State. A later determination by Rama Murthy and Sadashivaiah (1967, p. 73) on rocks presumably collected from the same area on whole rock and separated minerals gave a Sr-Rb isochron age of 2740 m.y. The whole rock data alone made it 3100 m.y. but the range of points on the isochron is not satisfactory. Satnur is not the ideal place in Mysore State to collect typical specimens of charnockite as it is situated in the transition zone between the Peninsular gneisses and charnockites.

Biotite from Peninsular gneiss immediately next to a patch of charnockite in the Kabbaldurga quarries gave an age of 1400 m.y. (Venkatasubramaniam, personal communication). It is interesting to note that this date is identical with that obtained by Afanassyev (*vide supra*) for the potash metasomatism which affected the Madras rocks.

Some dates available for charnockites outside Mysore State also do not help in solving this problem. An acid charnockite from St. Thomas Mount, Madras, with a present-day Sr^{87}/Sr^{86} ratio of 0·9182 gives a maximum indicated age of 2650 m.y. at initial ratio 0·700. According to Crawford (1969, p. 152) who analysed this rock, it is not possible with such a present-day ratio to certainly say that its age exceeds 2550 m.y. which is the approximate age of Peninsular gneiss near Bangalore.

Again, charnockites from the Nilgiri hills do not provide much information about their ages, since these rocks are rather poorly enriched. One specimen examined by Crawford is moderately enriched (present-day ratio-0·8279) and its maximum indicated age is 2675 m.y. but he has come to the conclusion that 'it is necessary to analyse more samples before stating that the charnockitic rocks of the Nilgiris are undoubtedly older, if only slightly older, than the Peninsular gneiss of Bangalore' (Crawford, 1969, p. 152).

In Kerala State, two specimens collected from a few kilometres apart have given indicated ages of 3070 m.y. (garnet-sillimanite gneiss) and 2785 m.y. (charnockite), the former representing probably the oldest gneiss in South India (Crawford, 1969, pp. 159–160).

Parts of Kerala and Madras States lying in the extreme south of the Peninsula composed of both gneisses and charnockites, and where granulite facies rocks are predominant, may constitute the lowest section of the Precambrian formations so far known in South India. Much more field and geochronological data are required, however, to come to a definite conclusion regarding the relative ages of the charnockites and Peninsular gneisses.

1. Afanassyev, G. D. *et al.*, "Physical properties and absolute ages of some rocks from India and Ceylon," *Proc. U.S.S.R. Acad. Sci., Geol Ser. No. 1* (in Russian), 1964.
2. Belousov, V. V., "Modern concepts of the structure and development of the earth's crust and the upper mantle of continents," *Quar. Jour. Geol. Soc.*, 1966, **122.**
3. Cahen, L. and Lepersonne, J., "The Precambrian of the Congo, Rwanda and Burundi," In *The Geologic Systems : The Precambrian*, Interscience Publishers, New York, 1967, **3.**
4. Holland, T. H., "The charnockite series, a group of Archæan hypersthenic rocks in Peninsular India," *Memoir Geol. Surv. India*, 1900, **28.**
5. —, "Geology of the neighbourhood of Salem, Madras Presidency," *Ibid.*, 1901, **30.**
6. Klimov, L. V., Ravich, M. G. and Soloviev, D. S., "Charnockites of East Antarctica," *Antarctic Geology*, North-Holland Publishing Co., Amsterdam, 1964.
7. Krishnan, M. S., *Geology of India and Burma*, 5th Edition, Higginbothams Ltd., Madras, 1968.
8. McLeod, I. R., "An outline of the geology of the sector from Long. 45° to 80° E, Antarctica," *Antarctic Geology*, North Holland Publishing Co Amsterdam, 1964.

9. Narayanaswamy, S., "Archæan province of Madras—Kerala region, Symposium on Stratigraphy. Age and Correlation of the Archæan Provinces of India." *Geol. Soc. India, Proc. and Abstracts*, 1964.
10. Narasimha Rao, P., "Studies on some granitic rocks of Palni-Dindigal area, Tamil Nadu," *Jour. Geol. Soc. India*, 1969, **10**.
11. Pascoe, E., *A Manual of the Geology of India and Burma*, 3rd Edition, Calcutta, 1950, **1**.
12. Pichamuthu, C. S., "Some observations on the structure and classification of the Dharwars of Mysore State," *Curr. Sci.*, 1951, **20**.
13. —, "Metamorphic facies in Mysore State," *Mysore Geologists' Assoc. Inf. Circ.*, 1953 *a*, No. 47.
14. —, *The Charnockite Problem*, Mysore Geologists' Assoc. Special Publication, Bangalore, 1953 *b*.
15. —"The charnockites of South India," *Proc. Pan. Ind. Ocean. Sci. Cong.*, Sect. C. Perth, 1954
16. —, "The significance of clouded plagioclase in the basic dykes of Mysore State, India," *Jour. Geol. Soc., Ind.*, 1959 *a*, **1**.
17. —, "On the use of the term charnockite dyke," *Curr. Sci.*, 1959 *b*, **28**.
18. —, "Charnockite in the making," *Nature*, 1960, **188**.
19. —, "Transformation of Peninsular gneiss into charnockite in Mysore State, India," *Jour. Geol. Soc. India*, 1961 *a*, **2**.
20. —, "Tectonics of Mysore State," *Proc. Ind. Acad. Sci.*, 1961 *b*, **53**.
21. —, "Regional metamorphism and charnockitization in Mysore State, India," *Indian Mineralogist*, 1965, **6**.
22. Pichamuthu, C. S., "The problem of the basement in Mysore State," *Curr. Sci.*, 1970, **39**.
23. Radhakrishna, B. P., "Some aspects of the stratigrapny and structure of the Dharwars of Mysore, South India—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
24. Rama Murthy, V. and Sadashivaiah, M. S., "Rubidium-strontium age of charnockite and other rocks from the Precambrian complex, Mysore, India," *Conference on Geochronology of Precambrian Stratified Rocks, University of Alberta, Abstract*, 1967.
25. Rama Rao, B., "Recent studies on the Archæan complex of Mysore," *Pres. Address, Section of Geology and Geography, 23rd Ind. Sci. Congress*, 1936.
26. —, "The charnockite rocks of Mysore (Southern India)," *Bull. Mysore Geol. Dept.*, 1945, No. 18.
27. Sadashivaiah, M. S. and Naganna, C., "Dating the post-Dharwar crystallines of Mysore State—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
28. Subramaniam, A. P., "Charnockite of the type area near Madras—A reinterpretation," *Amer. Jour. Sci.*, 1959, **257**.
29. Viswanathan, T. V., "The granulitic rocks of the Indian Precambrian shield," *Mem. Geol. Surv. Ind.*, 1969, **100**.

ATMOSPHERIC OSCILLATIONS OF 4-5-DAY PERIOD

R. ANANTHAKRISHNAN AND B. M. MISHRA

Institute of Tropical Meteorology, Poona

IN a paper published in the Memoirs of the India Meteorological Department 75 years ago, Eliot (1895) drew attention to short period barometric oscillations with a mean period of 4–5 days, (periods in individual cases ranging from 2 to 8 or 9 days), which occurred nearly simultaneously over India and neighbourhood. According to him, these oscillations are "a normal and regular feature of the meteorology of India".

Eliot's work has remained unnoticed in the literature. Nearly fifty years later Frolow (1942) reported the existence of "widespread stationary oscillations of 5 or 6 days' period" over the Caribbean and western Indian Ocean. Similar oscillations were noticed over the equatorial Pacific by Palmer and Ohmstede (1956). These authors have suggested that the pressure oscillations may be due to extra-terrestrial causes such as solar flares. Pisharoty (1957) found evidence for such oscillation in the upper atmosphere by examining the height variations of standard isobaric levels at radiosonde stations over India and adjacent areas. He has also favoured the solar flare hypothesis as a possible mechanism.

In a recent study Wallace and Chang (1969) have examined the surface pressure data of 15 tropical stations between 8° S and 19° N distributed round the globe and have concluded that the 4–5-day pressure oscillation is a "westward propagating wave with a zonal wavelength equal to the circumference of the earth".

For the proper understanding of these oscillations it is important to know: (*i*) the seasonal and latitudinal behaviour of the oscillations as regards their period and amplitude; (*ii*) the latitudinal extent to which they can be traced; (*iii*) whether they are stationary or propagat-

[illegible] and [illegible] whether their origin is to be attributed to terrestrial or extra-terrestrial [illegible] these questions can be answered only after [illegible] of pressure data of [illegible] round the globe for a [illegible] complete solar cycle.

[illegible] we have [illegible] examined the 24-hour [illegible] seven Indian stations [illegible] 1964 which covers [illegible] 1964 and [illegible] stations chosen for [illegible] Madras, Bombay, [illegible] New Delhi and Srinagar [illegible] from 8° N to [illegible] the following [illegible]

[illegible] pressure oscil[illegible] at all stations [illegible]

(ii) The amplitude of the oscillation increases from Trivandrum to Srinagar. The northern stations show slightly larger amplitude in the [illegible] there is little variation at the southern stations.

(iii) The oscillations do not show any [illegible] the phase of the solar cycle [illegible] regarded as terrestrial [illegible] origin.

The fact that the 4–5-day pressure oscillations are [illegible] very conspicuously at Srinagar [illegible] investigate whether they can be [illegible] still higher latitude. For [illegible] examined the daily 24-hour pressure tendencies at the following four [illegible] three USSR stations for 1964 and 1965.

S. No.	Station	Lat. (N.)	Long. (E.)
(i)	Kagoshima	31° 34′	130° 33′
(ii)	Tokyo	35° 41′	139° 46′
(iii)	Akita	39° 43′	140° 06′
(iv)	Wakkanai	45° 25′	141° 41′
(v)	Blagoveschensk	50° 16′	127° 30′
(vi)	Vanavara	60° 20′	102° 16′
(vii)	Ojmjakon	63° 16′	143° 09′

The daily pressure data were extracted from the *Japanese Daily Weather Reports* which also contained the data of the USSR stations in question. It has been found that the 4–5-day pressure oscillations exist at all these stations. The behaviour of the oscillations as regards period is practically the same as at the Indian and other tropical stations, but the amplitude is found to be higher at the high latitude stations.

Our study leads to the conclusion that the 4–5-day pressure oscillation is not a phenomenon confined to the tropics but is perhaps global in character and that its origin cannot be extra terrestrial. We are currently engaged in a study of the daily pressure data of selected stations in zonal belts of both the hemispheres.

1. Eliot, J., "A preliminary discussion of certain oscillatory changes of pressure of long period and short period in India," *Ind. Met. Mem.*, 1895, **6**, 89.
2. Frolow, S., "On synchronous variations of pressure in tropical regions," *Bull. Am. Met. Soc.*, 1942, **23**, 239.
3. Palmer, C. E. and Ohmstede, D. W., "The simultaneous oscillation of barometers along and near the equator," *Tellus*, 1956, **498**, 5.
4. Pisharoty, P. R., "Stationary medium range oscillations of pressure over the African Indo-Philippine Tropical Belt," *IUGG Symposium, Toronto*, 1957.
5. Wallace, J. M. and Chang, C. P., "Spectrum analysis of large-scale wave disturbances in the tropical lower troposphere," *J. At. Sci.*, 1969, **26**, 1010.

9. Narayanaswamy, S., "Archæan province of Madras—Kerala region, Symposium on Stratigraphy. Age and Correlation of the Archæan Provinces of India." *Geol. Soc. India, Proc. and Abstracts*, 1964.
10. Narasimha Rao, P., "Studies on some granitic rocks of Palni-Dindigal area, Tamil Nadu," *Jour. Geol. Soc. India*, 1969, **10.**
11. Pascoe, E., *A Manual of the Geology of India and Burma*, 3rd Edition, Calcutta, 1950, **1.**
12. Pichamuthu, C. S., "Some observations on the structure and classification of the Dharwars of Mysore State," *Curr. Sci.*, 1951, **20.**
13. —, "Metamorphic facies in Mysore State," *Mysore Geologists' Assoc. Inf. Circ.*, 1953 *a*, No. 47.
14. —, *The Charnockite Problem*, Mysore Geologists' Assoc. Special Publication, Bangalore, 1953 *b*.
15. —"The charnockites of South India," *Proc. Pan. Ind. Ocean. Sci. Cong.*, Sect. C. Perth, 1954
16. —, "The significance of clouded plagioclase in the basic dykes of Mysore State, India," *Jour. Geol. Soc., Ind.*, 1959 *a*. **1.**
17. —, "On the use of the term charnockite dyke," *Curr. Sci.*, 1959 *b*, **28.**
18. —, "Charnockite in the making," *Nature*, 1960, **188.**
19. —, "Transformation of Peninsular gneiss into charnockite in Mysore State, India," *Jour. Geol. Soc. India*, 1961 *a*, **2.**
20. —, "Tectonics of Mysore State," *Proc. Ind. Acad. Sci.*, 1961 *b*, **53.**
21. —, "Regional metamorphism and charnockitization in Mysore State, India," *Indian Mineralogist*, 1965, **6.**
22. Pichamuthu, C. S., "The problem of the basement in Mysore State," *Curr. Sci.*, 1970, **39.**
23. Radhakrishna, B. P., "Some aspects of the stratigrapny and structure of the Dharwars of Mysore, South India—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
24. Rama Murthy, V. and Sadashivaiah, M. S., "Rubidium-strontium age of charnockite and other rocks from the Precambrian complex, Mysore, India," *Conference on Geochronology of Precambrian Stratified Rocks, University of Alberta, Abstract*, 1967.
25. Rama Rao, B., "Recent studies on the Archæan complex of Mysore," *Pres. Address, Section of Geology and Geography, 23rd Ind. Sci. Congress*, 1936.
26. —, "The charnockite rocks of Mysore (Southern India)," *Bull. Mysore Geol. Dept.*, 1945, No. 18.
27. Sadashivaiah, M. S. and Naganna, C., "Dating the post-Dharwar crystallines of Mysore State—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
28. Subramaniam, A. P., "Charnockite of the type area near Madras—A reinterpretation," *Amer. Jour. Sci.*, 1959, **257.**
29. Viswanathan, T. V., "The granulitic rocks of the Indian Precambrian shield," *Mem. Geol. Surv. Ind.*, 1969, **100.**

ATMOSPHERIC OSCILLATIONS OF 4-5-DAY PERIOD

R. ANANTHAKRISHNAN AND B. M. MISHRA

Institute of Tropical Meteorology, Poona

In a paper published in the Memoirs of the India Meteorological Department 75 years ago, Eliot (1895) drew attention to short period barometric oscillations with a mean period of 4–5 days, (periods in individual cases ranging from 2 to 8 or 9 days), which occurred nearly simultaneously over India and neighbourhood. According to him, these oscillations are "a normal and regular feature of the meteorology of India".

Eliot's work has remained unnoticed in the literature. Nearly fifty years later Frolow (1942) reported the existence of "widespread stationary oscillations of 5 or 6 days' period" over the Caribbean and western Indian Ocean. Similar oscillations were noticed over the equatorial Pacific by Palmer and Ohmstede (1956). These authors have suggested that the pressure oscillations may be due to extra-terrestrial causes such as solar flares. Pisharoty (1957) found evidence for such oscillation in the upper atmosphere by examining the height variations of standard isobaric levels at radiosonde stations over India and adjacent areas. He has also favoured the solar flare hypothesis as a possible mechanism.

In a recent study Wallace and Chang (1969) have examined the surface pressure data of 15 tropical stations between 8° S and 19° N distributed round the globe and have concluded that the 4–5-day pressure oscillation is a "westward propagating wave with a zonal wavelength equal to the circumference of the earth".

For the proper understanding of these oscillations it is important to know: (*i*) the seasonal and latitudinal behaviour of the oscillations as regards their period and amplitude; (*ii*) the latitudinal extent to which they can be traced; (*iii*) whether they are stationary or propagat-

[illegible] and [illegible] whether their origin is to be attributed to terrestrial or extra-terrestrial causes. All these questions can be answered only after a detailed study of pressure data of representative stations round the globe for a few years, preferably a complete solar cycle.

In connection with such a study we have, in the first instance, examined the 24-hour [illegible] data of seven Indian stations for the 12 years [illegible] 1950-61, which covers the sunspot minimum in 1954 and sunspot maximum in [illegible]. The stations chosen for [illegible] are Trivandrum, Madras, Bombay, Nagpur, Calcutta, New Delhi and Srinagar covering the latitude interval from 8° N to 34° N. The [illegible] brought out the following results:

(i) The periodicity of the pressure oscillations is between 4 and 5 days at all stations irrespective of season.

(ii) The amplitude of the oscillations increases from Trivandrum to Srinagar. The northern stations show slightly larger amplitude in the winter months while there is little variation at the southern station.

(iii) The oscillations do not show any dependence on the phase of the solar cycle; hence they have to be regarded as terrestrial in origin.

The fact that the 4-5-day pressure oscillations are noticed very conspicuously at Srinagar, led us to investigate whether they can be traced at still higher latitudes. For this purpose, we have examined the daily 24-hour pressure tendencies at the following four Japanese and three USSR stations for 1964 and 1965.

S. No.	Station	Lat. (N.)	Long. (E.)
(i)	Kagoshima	31° 34′	130° 33′
(ii)	Tokyo	35° 41′	139° 46′
(iii)	Akita	39° 43′	140° 06′
(iv)	Wakkanai	45° 25′	141° 41′
(v)	Blagovescensk	50° 16′	127° 30′
(vi)	Vanavara	60° 20′	102° 16′
(vii)	Ojmjakon	63° 16′	143° 09′

The daily pressure data were extracted from the *Japanese Daily Weather Reports* which also contained the data of the USSR stations in question. It has been found that the 4-5-day pressure oscillations exist at all these stations. The behaviour of the oscillations as regards period is practically the same as at the Indian and other tropical stations, but the amplitude is found to be higher at the high latitude stations.

Our study leads to the conclusion that the 4-5-day pressure oscillation is not a phenomenon confined to the tropics but is perhaps global in character and that its origin cannot be extra-terrestrial. We are currently engaged in a study of the daily pressure data of selected stations in zonal belts of both the hemispheres.

---

1. Eliot, J., "A preliminary discussion of certain oscillatory changes of pressure of long period and short period in India," *Ind. Met. Mem.*, 1895, **6**, 89.
2. Frolow, S., "On synchronous variations of pressure in tropical regions," *Bull. Am. Met. Soc.*, 1942, **23**, 239.
3. Palmer, C. E. and Ohmstede, D. W., "The simultaneous oscillation of barometers along and near the equator," *Tellus*, 1956, **498**, 5.
4. Pisharoty, P. R., "Stationary medium range oscillations of pressure over the African Indo-Philippine Tropical Belt," *IUGG Symposium, Toronto*, 1957.
5. Wallace, J. M. and Chang, C. P., "Spectrum analysis of large-scale wave disturbances in the tropical lower troposphere," *J. At. Sci.*, 1969, **26**, 1010.

9. Narayanaswamy, S., "Archæan province of Madras—Kerala region, Symposium on Stratigraphy. Age and Correlation of the Archæan Provinces of India." *Geol. Soc. India, Proc. and Abstracts*, 1964.
10. Narasimha Rao, P., "Studies on some granitic rocks of Palni-Dindigal area, Tamil Nadu," *Jour. Geol. Soc. India*, 1969, **10.**
11. Pascoe, E., *A Manual of the Geology of India and Burma*, 3rd Edition, Calcutta, 1950, **1.**
12. Pichamuthu, C. S., "Some observations on the structure and classification of the Dharwars of Mysore State," *Curr. Sci.*, 1951, **20.**
13. —, "Metamorphic facies in Mysore State," *Mysore Geologists' Assoc. Inf. Circ.*, 1953 *a*, No. 47.
14. —, *The Charnockite Problem*, Mysore Geologists' Assoc. Special Publication, Bangalore, 1953 *b*.
15. —"The charnockites of South India," *Proc. Pan. Ind. Ocean. Sci. Cong.*, Sect. C. Perth, 1954.
16. —, "The significance of clouded plagioclase in the basic dykes of Mysore State, India," *Jour. Geol. Soc., Ind.*, 1959 *a*, **1.**
17. —, "On the use of the term charnockite dyke," *Curr. Sci.*, 1959 *b*, **28.**
18. —, "Charnockite in the making," *Nature*, 1960, **188.**
19. —, "Transformation of Peninsular gneiss into charnockite in Mysore State, India," *Jour. Geol. Soc. India*, 1961 *a*, **2.**
20. —, "Tectonics of Mysore State," *Proc. Ind. Acad. Sci.*, 1961 *b*, **53.**
21. —, "Regional metamorphism and charnockitization in Mysore State, India," *Indian Mineralogist*, 1965, **6.**
22. Pichamuthu, C. S., "The problem of the basement in Mysore State," *Curr. Sci.*, 1970, **39.**
23. Radhakrishna, B. P., "Some aspects of the stratigraphy and structure of the Dharwars of Mysore, South India—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
24. Rama Murthy, V. and Sadashivaiah, M. S., "Rubidium-strontium age of charnockite and other rocks from the Precambrian complex, Mysore, India," *Conference on Geochronology of Precambrian Stratified Rocks, University of Alberta, Abstract*, 1967.
25. Rama Rao, B., "Recent studies on the Archæan complex of Mysore," *Pres. Address, Section of Geology and Geography, 23rd Ind. Sci. Congress*, 1936.
26. —, "The charnockite rocks of Mysore (Southern India)," *Bull. Mysore Geol. Dept.*, 1945, No. 18.
27. Sadashivaiah, M. S. and Naganna, C., "Dating the post-Dharwar crystallines of Mysore State—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
28. Subramaniam, A. P., "Charnockite of the type area near Madras—A reinterpretation," *Amer. Jour. Sci.*, 1959, **257.**
29. Viswanathan, T. V., "The granulitic rocks of the Indian Precambrian shield," *Mem. Geol. Surv. Ind.*, 1969, **100.**

ATMOSPHERIC OSCILLATIONS OF 4-5-DAY PERIOD

R. ANANTHAKRISHNAN AND B. M. MISHRA

Institute of Tropical Meteorology, Poona

IN a paper published in the Memoirs of the India Meteorological Department 75 years ago, Eliot (1895) drew attention to short period barometric oscillations with a mean period of 4–5 days, (periods in individual cases ranging from 2 to 8 or 9 days), which occurred nearly simultaneously over India and neighbourhood. According to him, these oscillations are "a normal and regular feature of the meteorology of India".

Eliot's work has remained unnoticed in the literature. Nearly fifty years later Frolow (1942) reported the existence of "widespread stationary oscillations of 5 or 6 days' period" over the Caribbean and western Indian Ocean. Similar oscillations were noticed over the equatorial Pacific by Palmer and Ohmstede (1956). These authors have suggested that the pressure oscillations may be due to extra-terrestrial causes such as solar flares. Pisharoty (1957) found evidence for such oscillation in the upper atmosphere by examining the height variations of standard isobaric levels at radiosonde stations over India and adjacent areas. He has also favoured the solar flare hypothesis as a possible mechanism.

In a recent study Wallace and Chang (1969) have examined the surface pressure data of 15 tropical stations between 8° S and 19° N distributed round the globe and have concluded that the 4–5-day pressure oscillation is a "westward propagating wave with a zonal wavelength equal to the circumference of the earth".

For the proper understanding of these oscillations it is important to know: (*i*) the seasonal and latitudinal behaviour of the oscillations as regards their period and amplitude; (*ii*) the latitudinal extent to which they can be traced; (*iii*) whether they are stationary or propagat-

ns, and (iii) whether their origin is to be attributed to terrestrial or extra-terrestrial causes. All these questions can be answered only after a detailed study of pressure data of representative stations round the globe for a few years, preferably a complete solar cycle.

In connection with such a study we have, in the first instance, examined the 24-hour pressure tendency data of seven Indian stations for the 12-year period 1950-61, which covers the largest sunspot minimum in 1954 and sunspot maximum in 1957. The stations chosen for this are Trivandrum, Madras, Bombay, Nagpur, Calcutta, New Delhi and Srinagar covering the latitude interval from 8° N to 34° N. This study has brought out the following results:

(i) The mean period of the oscillations are nearly stable, between 4 and 5 days at all stations irrespective of season.

(ii) The amplitude of the oscillations increases from Trivandrum to Srinagar. The northern stations show slightly larger amplitude in the winter months, while there is little variation at the southern stations.

(iii) The oscillations do not show any dependence on the phases of the solar cycle. Hence they can be regarded as terrestrial in origin.

The fact that the 4-5-day pressure oscillations are better seen comparatively at Srinagar, led us to investigate whether they can be traced at still higher latitudes. For this purpose, we have examined the daily 24-hour pressure tendencies at the following four Japanese and three USSR stations for 1964 and 1965:

S. No.	Station	Lat. (N.)	Long. (E.)
(i)	Kagoshima	31° 34′	130° 33′
(ii)	Tokyo	35° 41′	139° 46′
(iii)	Akita	39° 43′	140° 06′
(iv)	Wakkanai	45° 25′	141° 41′
(v)	Blagoveśćensk	50° 16′	127° 30′
(vi)	Vanavara	60° 20′	102° 16′
(vii)	Ojmjakon	63° 16′	143° 09′

The daily pressure data were extracted from the *Japanese Daily Weather Reports* which also contained the data of the USSR stations in question. It has been found that the 4-5-day pressure oscillations exist at all these stations. The behaviour of the oscillations as regards period is practically the same as at the Indian and other tropical stations, but the amplitude is found to be higher at the high latitude stations.

Our study leads to the conclusion that the 4-5-day pressure oscillation is not a phenomenon confined to the tropics but is perhaps global in character and that its origin cannot be extra terrestrial. We are currently engaged in a study of the daily pressure data of selected stations in zonal belts of both the hemispheres.

1. Eliot, J., "A preliminary discussion of certain oscillatory changes of pressure of long period and short period in India," *Ind. Met. Mem.*, 1895, **6**, 89.
2. Frolow, S., "On synchronous variations of pressure in tropical regions," *Bull. Am. Met. Soc.*, 1942, **23**, 239.
3. Palmer, C. E. and Ohmstede, D. W., "The simultaneous oscillation of barometers along and near the equator," *Tellus*, 1956, **498**, 5.
4. Pisharoty, P. R., "Stationary medium range oscillations of pressure over the African Indo-Philippine Tropical Belt," *IUGG Symposium, Toronto*, 1957.
5. Wallace, J. M. and Chang, C. P., "Spectrum analysis of large-scale wave disturbances in the tropical lower troposphere," *J. At. Sci.*, 1969, **26**, 1010.

9. Narayanaswamy, S., "Archæan province of Madras—Kerala region, Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
10. Narasimha Rao, P., "Studies on some granitic rocks of Palni-Dindigal area, Tamil Nadu," *Jour. Geol. Soc. India*, 1969, **10.**
11. Pascoe, E., *A Manual of the Geology of India and Burma*, 3rd Edition, Calcutta, 1950, **1.**
12. Pichamuthu, C. S., "Some observations on the structure and classification of the Dharwars of Mysore State," *Curr. Sci.*, 1951, **20.**
13. —, "Metamorphic facies in Mysore State," *Mysore Geologists' Assoc. Inf. Circ.*, 1953 *a*, No. 47.
14. —, *The Charnockite Problem*, Mysore Geologists' Assoc. Special Publication, Bangalore, 1953 *b*.
15. —"The charnockites of South India," *Proc. Pan. Ind. Ocean. Sci. Cong.*, Sect. C, Perth, 1954
16. —, "The significance of clouded plagioclase in the basic dykes of Mysore State, India," *Jour. Geol. Soc., Ind.*, 1959 *a*, **1.**
17. —, "On the use of the term charnockite dyke," *Curr. Sci.*, 1959 *b*, **28.**
18. —, "Charnockite in the making," *Nature*, 1960, **188.**
19. —, "Transformation of Peninsular gneiss into charnockite in Mysore State, India," *Jour. Geol. Soc. India*, 1961 *a*, **2.**
20. —, "Tectonics of Mysore State," *Proc. Ind. Acad. Sci.*, 1961 *b*, **53.**
21. —, "Regional metamorphism and charnockitization in Mysore State, India," *Indian Mineralogist*, **1965, 6.**
22. Pichamuthu, C. S., "The problem of the basement in Mysore State," *Curr. Sci.*, 1970, **39.**
23. Radhakrishna, B. P., "Some aspects of the stratigraphy and structure of the Dharwars of Mysore, South India—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
24. Rama Murthy, V. and Sadashivaiah, M. S., "Rubidium-strontium age of charnockite and other rocks from the Precambrian complex, Mysore, India," *Conference on Geochronology of Precambrian Stratified Rocks, University of Alberta, Abstract*, 1967.
25. Rama Rao, B., "Recent studies on the Archæan complex of Mysore," *Pres. Address, Section of Geology and Geography, 23rd Ind. Sci. Congress*, 1936.
26. —, "The charnockite rocks of Mysore (Southern India)," *Bull. Mysore Geol. Dept.*, 1945, No. 18.
27. Sadashivaiah, M. S. and Naganna, C., "Dating the post-Dharwar crystallines of Mysore State—Symposium on Stratigraphy, Age and Correlation of the Archæan Provinces of India," *Geol. Soc. India, Proc. and Abstracts*, 1964.
28. Subramaniam, A. P., "Charnockite of the type area near Madras—A reinterpretation," *Amer. Jour. Sci.*, 1959, **257.**
29. Viswanathan, T. V., "The granulitic rocks of the Indian Precambrian shield," *Mem. Geol. Surv. Ind.*, **1969, 100.**

ATMOSPHERIC OSCILLATIONS OF 4-5-DAY PERIOD

R. ANANTHAKRISHNAN AND B. M. MISHRA
Institute of Tropical Meteorology, Poona

IN a paper published in the Memoirs of the India Meteorological Department 75 years ago, Eliot (1895) drew attention to short period barometric oscillations with a mean period of 4–5 days, (periods in individual cases ranging from 2 to 8 or 9 days), which occurred nearly simultaneously over India and neighbourhood. According to him, these oscillations are "a normal and regular feature of the meteorology of India".

Eliot's work has remained unnoticed in the literature. Nearly fifty years later Frolow (1942) reported the existence of "widespread stationary oscillations of 5 or 6 days' period" over the Caribbean and western Indian Ocean. Similar oscillations were noticed over the equatorial Pacific by Palmer and Ohmstede (1956). These authors have suggested that the pressure oscillations may be due to extra-terrestrial causes such as solar flares. Pisharoty (1957) found evidence for such oscillation in the upper atmosphere by examining the height variations of standard isobaric levels at radiosonde stations over India and adjacent areas. He has also favoured the solar flare hypothesis as a possible mechanism.

In a recent study Wallace and Chang (1969) have examined the surface pressure data of 15 tropical stations between 8° S and 19° N distributed round the globe and have concluded that the 4–5-day pressure oscillation is a "westward propagating wave with a zonal wavelength equal to the circumference of the earth".

For the proper understanding of these oscillations it is important to know: (*i*) the seasonal and latitudinal behaviour of the oscillations as regards their period and amplitude; (*ii*) the latitudinal extent to which they can be traced; (*iii*) whether they are stationary or propagat-

ing; and (*iv*) whether their origin is to be attributed to terrestrial or extra-terrestrial causes. All these questions can be answered only after a detailed study of pressure data of representative stations round the globe for a few years, preferably a complete solar cycle.

In connection with such a study we have, in the first instance, examined the 24-hour pressure tendency data of seven Indian stations for the 12-year period 1950–61, which covers the sunspot minimum in 1954 and sunspot maximum in 1957. The stations chosen for study are Trivandrum, Madras, Bombay, Nagpur, Calcutta, New Delhi and Srinagar covering the latitude interval from 8° N to 34° N. The study has brought out the following results:

(*i*) The mean period of the pressure oscillations is between 4 and 5 days at all stations irrespective of season.

(*ii*) The amplitude of the oscillations increases from Trivandrum to Srinagar. The northern stations show slightly larger amplitude in the winter months, while there is little variation at the southern stations.

(*iii*) The oscillations do not show any dependence on the phase of the solar cycle. Hence they have to be regarded as terrestrial in origin.

The fact, that the 4–5-day pressure oscillations are noticed very conspicuously at Srinagar, led us to investigate whether they can be traced at still higher latitudes. For this purpose, we have examined the daily 24-hour pressure tendencies at the following four Japanese and three USSR stations for 1964 and 1965:

S. No.	Station	Lat. (N.)	Long. (E.)
(i)	Kagoshima	31° 34′	130° 33′
(ii)	Tokyo	35° 41′	139° 46′
(iii)	Akita	39° 43′	140° 06′
(iv)	Wakkanai	45° 25′	141° 41′
(v)	Blagovescensk	50° 16′	127° 30′
(vi)	Vanavara	60° 20′	102° 16′
(vii)	Ojmjakon	63° 16′	143° 09′

The daily pressure data were extracted from the *Japanese Daily Weather Reports* which also contained the data of the USSR stations in question. It has been found that the 4–5-day pressure oscillations exist at all these stations. The behaviour of the oscillations as regards period is practically the same as at the Indian and other tropical stations, but the amplitude is found to be higher at the high latitude stations.

Our study leads to the conclusion that the 4–5-day pressure oscillation is not a phenomenon confined to the tropics but is perhaps global in character and that its origin cannot be extra-terrestrial. We are currently engaged in a study of the daily pressure data of selected stations in zonal belts of both the hemispheres.

---

1. Eliot, J., "A preliminary discussion of certain oscillatory changes of pressure of long period and short period in India," *Ind. Met. Mem.*, 1895, **6**, 89.
2. Frolow, S., "On synchronous variations of pressure in tropical regions," *Bull. Am. Met. Soc.*, 1942, **23**, 239.
3. Palmer, C. E. and Ohmstede, D. W., "The simultaneous oscillation of barometers along and near the equator," *Tellus*, 1956, **498**, 5.
4. Pisharoty, P. R., "Stationary medium-range oscillations of pressure over the African-Indo-Philippine Tropical Belt," *IUGG Symposium, Toronto*, 1957.
5. Wallace, J. M. and Chang, C. P., "Spectrum analysis of large-scale wave disturbances in the tropical lower troposphere," *J. At. Sci.*, 1969, **26**, 1010.

ESTABLISHMENT OF A DIPLOID CELL LINE FROM LARVAL TISSUES OF *AEDES VITTATUS* (BIGOT, 1861)

U. K. M. BHAT AND K. R. P. SINGH*
Virus Research Centre, Poona, India

ABSTRACT

A diploid cell line from larval tissues of *Aedes vittatus* has been established. The cells grew as sheet on the glass surface and also as multicellular hollow vesicles floating in the medium. So far (July 1970) the cells from the attached sheet have undergone 34 passages. The hollow vesicles, which are also maintained as a separate sub-line, have undergone 12 passages. Cells from attached sheet and hollow vesicles have been stored in liquid nitrogen and regenerated successfully.

FOLLOWING the establishment of the first mosquito cell line by Grace[1] from *Aedes œgypti* larvæ, several workers have succeeded in establishing cell lines from different mosquito species: *Aedes œgypti* by Singh,[2] Peleg[3] and Varma and Pudney[4]; *Aedes albopictus* by Singh[2]; *Aedes vexans* and *Culiseta inornata* by Sweet and Dupree[5] and *Anopheles stephensi* by Schneider.[6] The present communication reports the establishment of another diploid cell line from larval tissues of *Aedes vittatus*.

The techniques used for setting up of the primary culture and maintenance of the cell line of *Aedes vittatus* were essentially the same as described by Singh.[2] The eggs were obtained from mosquitoes colonized in the laboratory. As the eggs surface-sterilized with acetone failed to hatch, they were surface-sterilized by washing first with 70% ethanol for 2–3 minutes and keeping them immersed in White's solution[2] for about 10 minutes. These eggs were washed thoroughly with sterile glass-distilled water and kept for hatching in Rinaldini's salt solution[2] (RSS), under reduced pressure. Most of the eggs hatched within one hour. The freshly hatched larvæ along with 1–2 ml. of RSS were transferred to a small tube and were minced. Five ml. of 0·1% trypsin (1 : 250, Difco) in RSS was added to the minced larval tissues and the suspension incubated at 37° C. for 10 minutes. After incubation the larval cells and tissue fragments were washed once with RSS to remove the trypsin, resuspended in 1 ml. of the culture medium, and seeded into a Porter's flask. The culture was incubated at 30° C. in a stationary position.

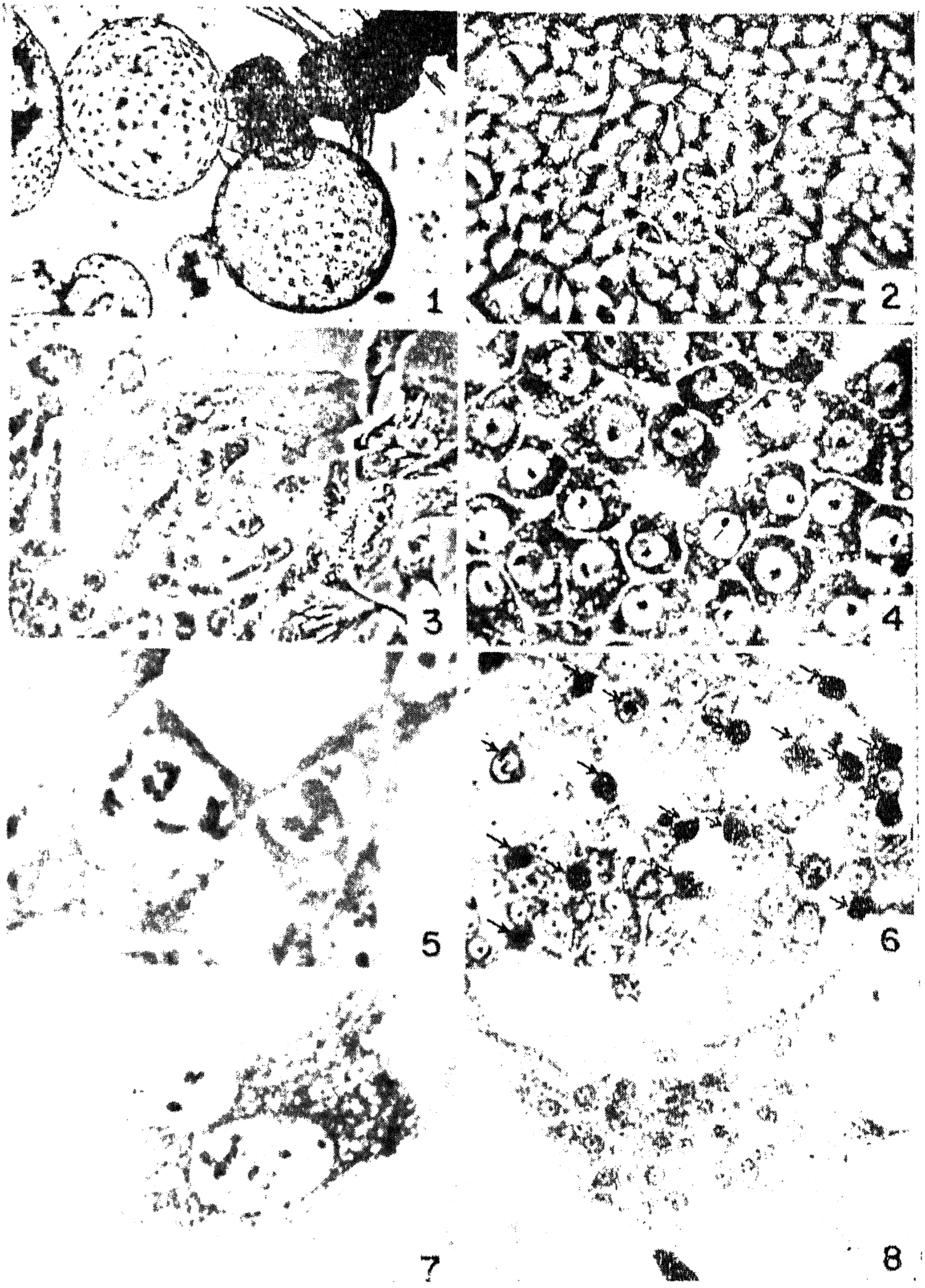
The culture medium was similar to that used by Schneider[6] for growing *Anopheles stephensi* cells. The concentration of the various ingredients in 100 ml. of the medium was as follows: NaCl, 300 mg.; KCl, 110 mg.; $MgCl_2.6H_2O$, 114 mg.; $MgSO_4.7H_2O$, 40 mg.; $NaHCO_3$, 35 mg.; sucrose, 1,600 mg.; glucose, 70 mg.; trehalose, 50 mg.; cholesterol, 0·02 mg. (dissolved in 0·02 ml. 95% ethanol and 0·02 ml. 5% aqueous solution of tween 80); all the amino-acids (omitting L-tyrosin) of Grace's medium,[1] in the same quantity; 1 ml. of 10 × NCTC 135 medium (without amino-acids, inorganic salts and sugars); and 10 ml. inactivated fetal bovine serum. A few drops of 0·01% phenol red was added as pH indicator. The pH of the medium was adjusted to 6·9 before adding fetal bovine serum. The concentration of antibiotics used was, 100 units of penicillin G (Sodium) and 0·1 mg. of streptomycin sulphate per ml.

The cells were grown on coverslips in Leighton tubes for the study of their morphology. Living cells were studied both under dark phase and bright phase illumination. For detailed cytological studies the cells were fixed in methyl alcohol and stained with Wright's and Giemsa stains.

A large number of cells and tissue pieces were found attached to the glass surface by the second day after setting up of the culture. Small patches of cells growing on the glass surface and a large number of small bubble-like structures growing at the cut ends of floating larval fragments were observed by the fourth day. These bubbles further increased in number and size, and formed multicellular hollow vesicles (Fig. 1), similar to those observed in the cultures of *Aedes œgypti*.[7] On the thirteenth day, when a complete monolayer of cells was observed on the glass surface, the floating hollow vesicles, and the cells attached to the glass surface were subcultured separately, in the manner described for *Aedes œgypti* cultures.[2,7] Subsequent subcultures both from the cells attached to the glass surface and the floating hollow vesicles were made

---

[*] Present address: Senior Scientist/Entomologist, WHO Research Unit on Genetic Control of Culicine Mosquitoes, 2 & 3, Ring Road, Kilokri, New Delhi-14.



FIGS. 1-8. *Aedes vittatus* larval cell culture. Fig. 1. Hollow vesicles developing at the cut end of a floating larval tissue, living culture, × 80. Fig. 2. Cell sheet, living culture, bright phase, × 150. Fig. 3. Cell sheet, living culture, dark phase, × 200. Fig. 4. Type A, epithelial-like cells, stained with Wright's and Giemsa, × 600. Fig. 5. Type A, epithelial-like cells showing mitosis, stained with Wright's and Giemsa, × 1,300. Fig. 6. Type A, epithelial-like cells, stained with Wright's and Giemsa, showing active mitosis, × 200. Fig. 7. Type B, epithelial-like cell, stained with Wright's and Giemsa, × 300. Fig. 8. Multinucleated giant cell, stained with Wright's and Giemsa, × 300.

once in six to eight days depending on the growth of the cells. The attached cells have so far (July, 1970) been subcultured 34 times. The hollow vesicles, were maintained as a separate subline. Their structure and development was observed to be similar to that of *A. œgypti*.[7] They were subcultured twelve times and then stored in liquid nitrogen at the thirteenth passage.

Three morphologically different cell types were observed to grow on the glass surface in the form of monolayers (Figs. 2, 3). Majority of these were epithelial-like cells and grew as compact sheet. These were of two types, smaller ones (Type A) and larger ones (Type B). The third type were multinucleated giant cells.

Epithelial-like Cells, Type A.—These were smaller, mononucleated, diploid ($2n = 6$) (Figs. 4, 5), and formed the major portion of the cell population both in the primary culture and in the established cell line. The cells were polygonal with well-defined cell boundaries, and measured from 10 to 20 μ in diameter. The cytoplasm was compact with uniformly distributed fine granules. A few broad pseudopodia-like ectoplasmic processes were observed in most of the cells. The nuclei were round, vesicular with well-defined nuclear membrane, and measured from 6 to 12 μ in diameter. The chromatin was thin and finely granular, with a distinct small nucleolus. Mitosis was frequently observed in these cells (Fig. 6).

Epithelial-like Cells, Type B.—These were few in number, both in the primary culture and in the established cell line, and were generally observed isolated or at the periphery of growing cell sheets. They were mono or multinucleated, round or polygonal, with ill-defined cell boundaries (Fig. 7). The cells were much larger in size and measured from 30 to 60 μ in diameter. The cytoplasm was densely granular, with a large number of small vacuoles usually distributed at the periphery of the cell. Many broad, pseudopodia-like ectoplasmic processes were observed in these cells. There were few, fairly large, bright bodies in the perinuclear region of the cytoplasm. Nuclei were round or oval, vesicular, with well-defined nuclear membrane. They measured from 14 to 25 μ in diameter. The chromatin was thinly granular with one or more round or irregular nucleoli. Mitosis was observed in these cells and the cells were generally tetraploid or polyploid.

Multinucleated Giant Cells.—These were very few in number both in the primary culture and in the cell line. They were syncytia-like in appearance with ill-defined mass of thin cytoplasm, having diffused boundaries (Fig. 8). They spread out from small masses of attached cells. The cytoplasm was thin, finely and sparsely granular, with a few vacuoles of varying size. A large number of round or oval, vesicular nuclei, measuring from 6 to 8 μ in diameter were found scattered in the cytoplasm. The chromatin was thin, and a distinct nucleolus was observed in each nucleus. Mitosis was often observed in the peripheral nuclei, and they had diploid chromosomes.

In addition to these three types, a few other types of cells, scattered in between the patches of epithelial-like cells, were observed only in the primary culture. Mitosis was not observed in any of these cells.

The cells from attached cell sheets as well as from floating hollow vesicles have been stored in liquid nitrogen in the culture medium containing 20% fetal bovine serum and 10% glycerol and successfully regenerated.

It was interesting to note that the general growth pattern of *A. vittatus* cells resembled closely with that of *A. œgypti*, though they were cultured in different media. In both the cultures epithelial-like cells formed the major portion of the cell population, which grew either in the form of monolayers on the glass surface or as spherical, multicellular hollow vesicles floating in the medium.

Attempts to culture *A. vittatus* larval cells in the medium in which several cell lines of other two closely related species, *A. œgypti* and *A. albopictus*, have been established by Singh,[2] were not successful.

---

1. Grace, T. D. C., *Nature*, 1966, **211**, 366.
2. Singh, K. R. P., *Curr. Sci.*, 1967, **36**, 506.
3. Peleg, J., *Virology*, 1968, **35**, 617.
4. Varma, M. G. R. and Pudney, M., *J. Med. Entomol.*, 1969, **6**, 432.
5. Sweet, B. M. and Dupree, L. T., *Mosquito News*, 1968, **28**, 368.
6. Schneider, I., *J. Cell Biol.*, 1969, **42**, 603.
7. Bhat, U. K. M. and Singh, K. R. P., *J. Med. Entomol.*, 1969, **6**, 71.

LETTERS TO THE EDITOR

THE K ABSORPTION EDGE OF GALLIUM IN GaSb, GaAs AND GaP

DURING the course of X-ray spectroscopic investigations on intermetallic compounds undertaken in this laboratory, we have recorded the K X-ray absorption discontinuity of gallium in metallic gallium and in three compounds GaSb, GaAs and GaP, using a Cauchois type bent crystal X-ray spectrograph of diameter 40 cm., with a mica crystal oriented to reflect from the (100) planes. The experimental technique used has been described in detail in earlier papers.[1-3]

The results of our measurements are given in Table I. The wavelength of the K discontinuity of gallium metal given by Cauchois[4] is indicated in this table for comparison. It is seen from the table that the gallium K absorption edge is progressively shifted towards the high energy side with respect to that in the metal in the order GaSb–GaAs–GaP. Our results do not agree with those of Nagasima[5] which show that there is no relative shift in the position of the gallium K absorption edge in GaAs and GaP. The chemical shifts seem to depend upon increasing crystalline ionicity of the compounds, which results because of the differences in the electronegativity values and the covalency effects. The percentage ionicities calculated by Suchet[6] for these compounds are given in column (6) of the table.

TABLE I

Absorber	λ in X.U.	Energy (E) eV	Δλ X.U.	ΔE eV	I%
Ga (Cauchois)[4]	1193·26	.	..	..	..
Ga (Authors)	1193·21	10390·0	..	..	..
GaSb	1193·08	10391·1	0·13	1·1	12
GaAs	1192·96	10392·2	0·25	2·2	37
GaP	1192·81	10393·5	0·40	3·5	62

The electronic structures of Ga, Sb, As and P are $4s^2 4p^1$, $5s^2 5p^3$, $4s^2 4p^3$ and $3s^2 3p^3$ respectively and are shown schematically in Fig. 1 *a*. The possible bonding schemes based on Pauling's valence bond theory for these compounds are shown in Fig. 1 *b* and 1 *c*. In Fig. 1 *b*, which represents a completely ionic configuration, the three electrons of gallium are transferred to the metalloid atom forming ionic bonds. In Fig. 1 *c*, which shows completely covalent bonding, one electron of gallium is promoted and one electron from the metalloid atom is transferred into the metal atom forming sp^3 covalent bonds. Both these pictures are extreme cases and an admixture of these two configurations must exist in any compound depending upon the degree of ionicity. Our measurements indicate that there is an admixture of the two types of bonding in these compounds, with a predominance of ionic bonding in the case of GaP and that of covalent bonding in GaSb. This admixture in the bonding suggested by us does not agree with the completely ionic bonding of $A^{3+}B^{3-}$ type suggested by Kantelhardt and Waidelich[7] for these compounds.

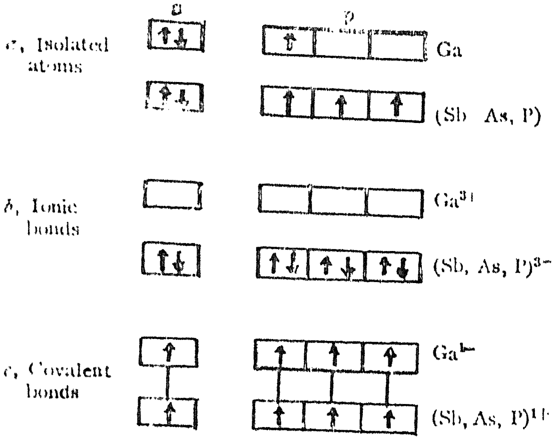


FIG. 1

We are thankful to the Directorate of Industries, Government of Maharashtra, Bombay, for financing the research scheme under which this work has been done.

Department of Physics, Nagpur University, Nagpur (India), *March* 28, 1970.
C. MANDE.
A. R. CHETAL.
V. B. SAPRE.

---

1. Mande, C. and Nigavekar, A. S., *Proc. Ind. Acad. Sci.*, 1967, **65 A**, 376.
2. —— and ——, *Ibid.*, 1968 **67 A**, 166.
3. —— and ——, *Ibid.*, 1969, **69 A**, 316.
4. Cauchois, Y. and Hulubei, H., *Tables de Constantes et Données Numériques*, Hermann, Paris, 1947.
5. Naoyuki Nagasima *Sci. Rep. Tohoku Univ. Japan*, 1966, **49** (2), 57.
6. Suchet, J. P., *Ann. Chem.*, 1965, **10** 517.
7. Kantelhardt, D. and Waidelich, W., *Z. Angew. Phys.*, 1969, **26** (3), 230.

once in six to eight days depending on the growth of the cells. The attached cells have so far (July, 1970) been subcultured 34 times. The hollow vesicles, were maintained as a separate subline. Their structure and development was observed to be similar to that of *A. ægypti.*[7] They were subcultured twelve times and then stored in liquid nitrogen at the thirteenth passage.

Three morphologically different cell types were observed to grow on the glass surface in the form of monolayers (Figs. 2, 3). Majority of these were epithelial-like cells and grew as compact sheet. These were of two types, smaller ones (Type A) and larger ones (Type B). The third type were multinucleated giant cells.

Epithelial-like Cells, Type A.—These were smaller, mononucleated, diploid ($2n = 6$) (Figs. 4, 5), and formed the major portion of the cell population both in the primary culture and in the established cell line. The cells were polygonal with well-defined cell boundaries, and measured from 10 to 20 μ in diameter. The cytoplasm was compact with uniformly distributed fine granules. A few broad pseudopodia-like ectoplasmic processes were observed in most of the cells. The nuclei were round, vesicular with well-defined nuclear membrane, and measured from 6 to 12 μ in diameter. The chromatin was thin and finely granular, with a distinct small nucleolus. Mitosis was frequently observed in these cells (Fig. 6).

Epithelial-like Cells, Type B.—These were few in number, both in the primary culture and in the established cell line, and were generally observed isolated or at the periphery of growing cell sheets. They were mono or multinucleated, round or polygonal, with ill-defined cell boundaries (Fig. 7). The cells were much larger in size and measured from 30 to 60 μ in diameter. The cytoplasm was densely granular, with a large number of small vacuoles usually distributed at the periphery of the cell. Many broad, pseudopodia-like ectoplasmic processes were observed in these cells. There were few, fairly large, bright bodies in the perinuclear region of the cytoplasm. Nuclei were round or oval, vesicular, with well-defined nuclear membrane. They measured from 14 to 25 μ in diameter. The chromatin was thinly granular with one or more round or irregular nucleoli. Mitosis was observed in these cells and the cells were generally tetraploid or polyploid.

Multinucleated Giant Cells.—These were very few in number both in the primary culture and in the cell line. They were syncytia-like in appearance with ill-defined mass of thin cytoplasm, having diffused boundaries (Fig. 8). They spread out from small masses of attached cells. The cytoplasm was thin, finely and sparsely granular, with a few vacuoles of varying size. A large number of round or oval, vesicular nuclei, measuring from 6 to 8 μ in diameter were found scattered in the cytoplasm. The chromatin was thin, and a distinct nucleolus was observed in each nucleus. Mitosis was often observed in the peripheral nuclei, and they had diploid chromosomes.

In addition to these three types, a few other types of cells, scattered in between the patches of epithelial-like cells, were observed only in the primary culture. Mitosis was not observed in any of these cells.

The cells from attached cell sheets as well as from floating hollow vesicles have been stored in liquid nitrogen in the culture medium containing 20% fetal bovine serum and 10% glycerol and successfully regenerated.

It was interesting to note that the general growth pattern of *A. vittatus* cells resembled closely with that of *A. ægypti*, though they were cultured in different media. In both the cultures epithelial-like cells formed the major portion of the cell population, which grew either in the form of monolayers on the glass surface or as spherical, multicellular hollow vesicles floating in the medium.

Attempts to culture *A. vittatus* larval cells in the medium in which several cell lines of other two closely related species, *A. ægypti* and *A. albopictus*, have been established by Singh,[2] were not successful.

---

1. Grace, T. D. C., *Nature*, 1966, **211**, 366.
2. Singh, K. R. P., *Curr. Sci.*, 1967, **36**, 506.
3. Peleg, J., *Virology*, 1968, **35**, 617.
4. Varma, M. G. R. and Pudney, M., *J. Med. Entomol.*, 1969, **6**, 432.
5. Sweet, B. M. and Dupree. L. T., *Mosquito News*, 1968, **28**, 368.
6. Schneider, I., *J. Cell Biol.*, 1969, **42**, 603.
7. Bhat, U. K. M. and Singh, K. R. P., *J. Med. Entomol.*, 1969, **6**, 71.

LETTERS TO THE EDITOR

THE K ABSORPTION EDGE OF GALLIUM IN GaSb, GaAs AND GaP

DURING the course of X-ray spectroscopic investigations on intermetallic compounds undertaken in this laboratory, we have recorded the K X-ray absorption discontinuity of gallium in metallic gallium and in three compounds GaSb, GaAs and GaP, using a Cauchois type bent crystal X-ray spectrograph of diameter 40 cm., with a mica crystal oriented to reflect from the (100) planes. The experimental technique used has been described in detail in earlier papers.[1–3]

The results of our measurements are given in Table I. The wavelength of the K discontinuity of gallium metal given by Cauchois[4] is indicated in this table for comparison. It is seen from the table that the gallium K absorption edge is progressively shifted towards the high energy side with respect to that in the metal in the order GaSb-GaAs-GaP. Our results do not agree with those of Nagasima[5] which show that there is no relative shift in the position of the gallium K absorption edge in GaAs and GaP. The chemical shifts seem to depend upon increasing crystalline ionicity of the compounds, which results because of the differences in the electronegativity values and the covalency effects. The percentage ionicities calculated by Suchet[6] for these compounds are given in column (6) of the table.

TABLE I

Absorber	λ in X.U.	Energy (E) eV	$\Delta\lambda$X.U.	ΔEeV	I%
Ga (Cauchois)	1193·26	..	..	..	..
Ga (Authors)	1193·21	10390·0	..	..	..
GaSb	1193·08	10391·1	−0·13	1·1	12
GaAs	1192·96	10392·2	−0·25	2·2	37
GaP	1192·81	10393·5	−0·40	3·5	62

The electronic structures of Ga, Sb, As and P are $4s^2 4p^1$, $5s^2 5p^3$, $4s^2 4p^3$ and $3s^2 3p^3$ respectively and are shown schematically in Fig. 1 *a*. The possible bonding schemes based on Pauling's valence bond theory for these compounds are shown in Figs. 1 *b* and 1 *c*. In Fig. 1 *b*, which represents a completely ionic configuration, the three electrons of gallium are transferred to the metalloid atom forming ionic bonds. In Fig. 1 c, which shows completely covalent bonding, one electron of gallium is promoted and one electron from the metalloid atom is transferred into the metal atom forming sp^3 covalent bonds. Both these pictures are extreme cases and an admixture of these two configurations must exist in any compound depending upon the degree of ionicity. Our measurements indicate that there is an admixture of the two types of bonding in these compounds, with a predominance of ionic bonding in the case of GaP and that of covalent bonding in GaSb. This admixture in the bonding suggested by us does not agree with the completely ionic bonding of $A^{3+}B^{3-}$ type suggested by Kantelhardt and Waidelich for these compounds.

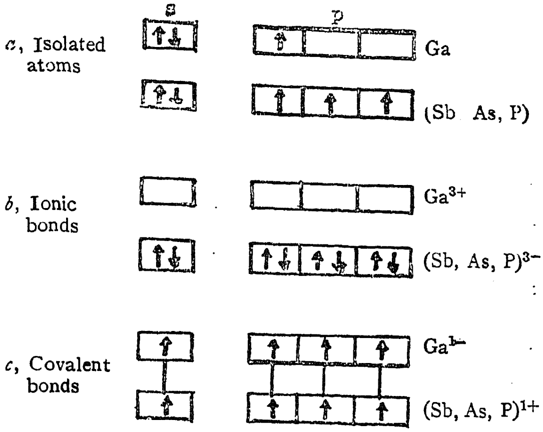


FIG. 1

We are thankful to the Directorate of Industries, Government of Maharashtra, Bombay, for financing the research scheme under which this work has been done.

Department of Physics, C. MANDE.
Nagpur University, A. R. CHETAL.
Nagpur (India), *March* 28, 1970. V. B. SAPRE.

---

1. Mande, C. and Nigavekar, A. S., *Proc. Ind. Acad. Sci.*, 1967, **65 A**, 376.
2. — and —, *Ibid.*, 1968. **67 A**, 166.
3. — and —, *Ibid.*, 1969, **69 A**, 316.
4. Cauchois, Y. and Hulubei, H., *Tables de Constantes et Données Numériques*, Hermann, Paris, 1947.
5. Naoyuki Nagasima. *Sci. Rep. Tohoku Univ. Japan*, 1966, **49** (2), 57.
6. Suchet, J P., *Ann. Chem.*, 1965, **10** 517.
7. Kantelhardt, D. and Waidelich, W., *Z. Angew. Phys.*, 1969, **26** (3), 239.

THE SPECTRUM OF FeCl IN THE RED

THE spectrum of FeCl was investigated in emission and absorption in the ultraviolet region λ 3150–λ 3700 Å by Meischer,[1] Mesnage,[2] Muller,[3] and Rao and Rao[5] and was analysed into three systems designated as I, II and '*a*'. Reddy and Rao[4] investigated the spectrum in the visible region λ 4690–λ 6560 Å and analysed the bands on the basis of four systems designated as III, IV, V and VI. However, the analysis of systems IV, V and VI was based on plates taken under low dispersion. The systems IV and V were too weak to be photographed under high dispersion. We therefore undertook the study of system VI under high dispersion with a view to study the structure of the bands in greater detail and to obtain more accurate vibrational constants.

The system VI of FeCl in the region λ 6340–6560 Å is excited in a high frequency discharge from a 500 watt oscillator and photographed in the first order of a 21 ft. concave grating spectrograph (dispersion 1·25 Å/mm.). Exposures of about 5–6 hr. gave good spectra on Kodak 103-aF Plates.

The system consists of three marked sequences of bands, the most intense of which is identified as $\Delta v = 0$ sequence. The bands in $\Delta v = 0$ sequence are seen to consist of two heads as shown in Fig. 1(*a*) with an average separation of 1·7 cm.$^{-1}$. As the bands in the $\Delta v = 0$ sequence are degraded towards shorter wavelengths, these were identified as P_1 and P_2 heads belonging to a transition of the type Σ–Σ with a multiplicity of 2. Owing to the near equality of the vibrational constants of the upper and lower states, the bands in the $\Delta v = +1$ sequence show a change in degradation. This feature can be seen from Fig. 1(*b*) which shows that most of the bands in the sequence are degraded to longer wavelengths. A few members of the $\Delta v = -1$ sequence are degraded towards shorter wavelengths. The data and classifications of the band heads are displayed in Table I. The P heads can be represented by the following quantum formula:

$$\nu_{v', v''} = 15434\cdot9 + 206\cdot4\,(v' + \tfrac{1}{2}) - 1\cdot8\,(v' + \tfrac{1}{2})^2 - 189\cdot8\,(v'' + \tfrac{1}{2}) + 1\cdot5\,(v'' + \tfrac{1}{2})^2.$$

The upper and lower states of the system do not appear to be related to any of the known low-lying electronic states of the FeCl molecule. They appear to correspond to transitions between two excited states of the FeCl molecule.

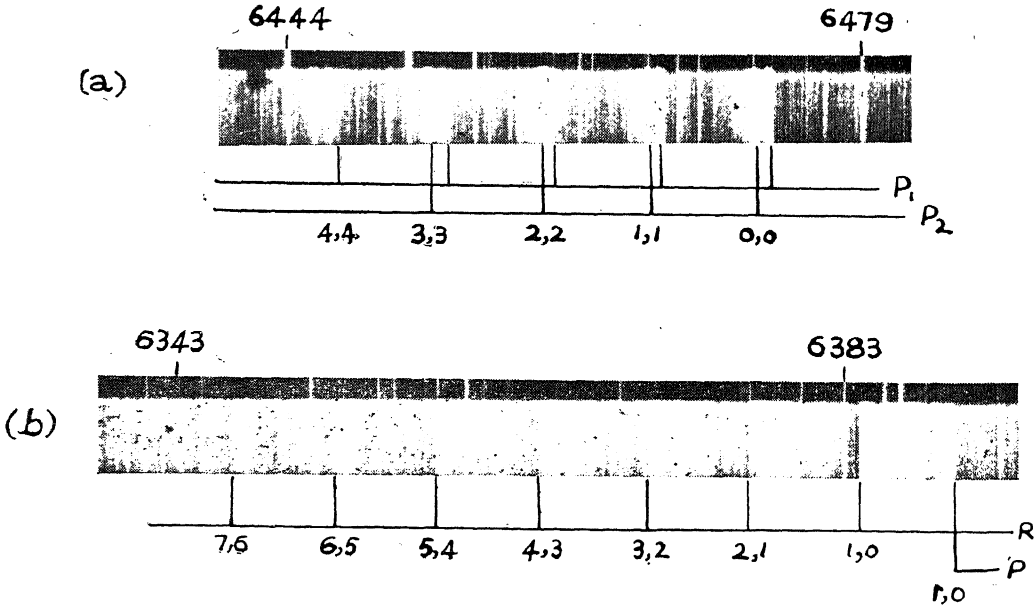


FIG. 1. (*a*) $\Delta v = 0$ Sequence of System VI of FeCl. (*b*) $\Delta v = +1$ Sequence of System VI of FeCl. (21 ft. Concave grating spectrogram.)

TABLE I

Band head data of system VI of FeCl

Wave-length Å	Wave-number cm.$^{-1}$	Intensity	Classification v', v''	Type of head
6346·05	15753·5	1	7, 6	R
6352·48	15737·5	2	6, 5	R
6358·65	15722·3	3	5, 4	R
6364·96	15706·7	5	4, 3	R
6371·23	15691·2	5	3, 2	R
6377·74	15675·2	7	2, 1	R
6384·16	15659·4	9	1, 0	R
6389·55	15646·2	5	1, 0	P
6447·35	15506·0	2	4, 4	P_1
6452·97	15492·5	5	3, 3	P_2
6454·03	15489·9	3	3, 3	P_1
6459·91	15475·8	5	2, 2	P_2
6460·46	15474·5	5	2, 2	P_1
6466·29	15460·5	8	1 1	P_2
6466·90	15459·1	8	1, 1	P_1
6472·81	15444·7	10	0, 0	P_2
6473·60	15443·1	10	0, 0	P_1
6544·73	15275·2	5	1, 2	P
6552·77	15256·5	2	0, 1	P

Spectroscopy Labs.,
Dept. of Physics,
Andhra University,
Waltair, *March* 9, 1970.

N. V. KRISHNA RAO.
D. V. K. RAO.
P. TIRUVENGANNA RAO.

---

1. Miescher, E., *Helv. Phys. Acta*, 1938, **11**, 463.
2. Mesnage, P., *Ann. De Phys.*, 1939, **12**, 5.
3. Muller, W., *Helv. Phys. Acta.*, 1943, **16**, 3.
4. Reddy, S. P. and Rao, P. T., *Jour. Mol. Spec.*, 1960, **4**, 16.
5. Rao, D. V. K. and Rao, P. T., *Curr. Sci.*, 1969, **38**, 87.

MEASUREMENT OF ANGULAR DISPLACEMENT BY HOLOGRAPHIC METHOD USING SPECKLE PATTERN

WHENEVER a scattering surface is illuminated with coherent light, speckles are formed owing to interference produced between the scattered and incident light. The size of the speckles depends upon the resolving limit of the imaging system; the smaller the resolving power, the higher the speckle size. If a scattered surface is illuminated by a single coherent beam, the speckles produced are of random phase and phase correlations do not exist between any two points on the scattering surface. When the same scattering surface is illuminated by another coherent beam we can superimpose a second speckle pattern on the first one. Under this condition phase relation does exist at each point on the surface between the two speckles formed by two coherent beams. Because of interference between the two speckles at each point, the phase relation between them is converted into intensity distribution. By photographing this intensity distribution, we can capture the phase relation for a particular position of the scattering surface. If the scattering surface, with the two original illuminating beams on, is viewed through the processed photographic plate, one observes uniformly attenuated illumination as each speckle coincides with its dark image on the photographic plate. Now by rotating the scattering surface the phase relation is altered and phase difference occurs between the speckles on the rotating surface and the original phase captured in the photographic plate. This phase difference produces interference pattern between the image of the original speckle pattern photographed and the image of the changed pattern superimposed on the plate. The interference fringes thus formed are the measure of the rotation of the scattering surface.

The experimental set-up is illustrated in Fig. 1. Laser beam is split into two components of almost equal intensity by means of beam splitter. The two beams are made to be incident on the rotating surface so that each is equally inclined on either side of the normal to the illuminating surface. The narrow beams are expanded with inverted microscope objectives suitably arranged as shown in the diagram. As the illuminating system is symmetrical about the Z-axis, any displacement along this axis causes no change in the phase difference, thereby making movement of the surface in this direction insensitive. Each

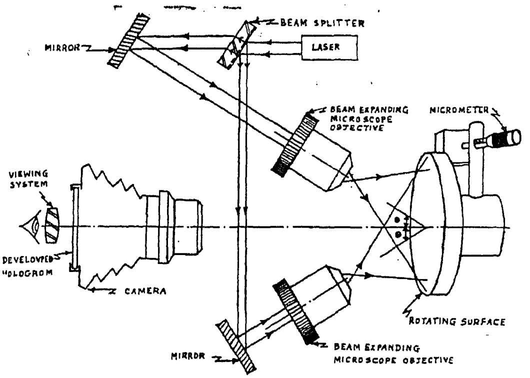


FIG. 1. Holographic determination of the in-plane rotation of a surface.

expanded beam produces a speckle pattern superimposed on one another in the plane of the scattering surface which could be rotated. A camera lens of required aperture is used and the speckle pattern is photographed. After processing, the photographic plate is repositioned exactly in its original place. It is noticed that the repositioning of the plate is very critical and it could be accurately done by using a kinematically designed plate holder.

With the laser beams still on, and as we rotate the scattering surface and view through an imaging system focussed on to the photographic plate, we observe the fringe system. As rotation is continued the number of fringes is increased, and it is found that the number of fringes thus formed is proportional to the amount of rotation. It is further observed that for very high rotations the number is so increased that the fringe contrast is entirely lost. Hence, it may be said that this method is useful for small and moderate angular displacements. One such fringe system is shown in Fig. 2. Here ten fringes are observed for an angular rotation of the surface through two seconds of an arc. It is evident from the figure that the fringe contrast is quite good to facilitate the counting of the fringes.

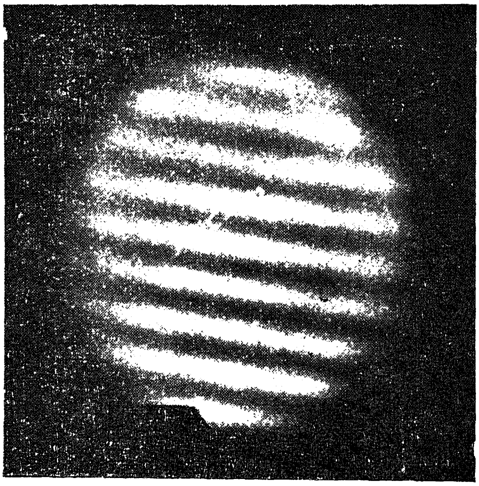


FIG. 2. Interference fringe system obtained on the rotation of a surface after repositioning the photographic plate.

This principle may also be conveniently applied to determine the twist produced on the surface of a body under torsion.

Dept. of Physics, V. VENKATESWARA RAO.
Regional Engg. College,
Warangal-4 (A.P.), *March* 30, 1970.

KINETICS OF OXIDATION OF MANDELIC ACID BY LEAD TETRAACETATE

THOUGH lead tetraacetate (LTA) is known to cleave α-hydroxy acids,[1,2] very little work has been done on the kinetics of these oxidations. We have now investigated the oxidation of mandelic acid and substituted mandelic acids in three binary solvent systems, namely, acetic acid-water, acetic acid-nitrobenzene, and acetic acid-benzene. The oxidation is totally of the second order being first with respect to the concentration of the hydroxy acid and also first with respect to tetravalent lead (Fig. 1).

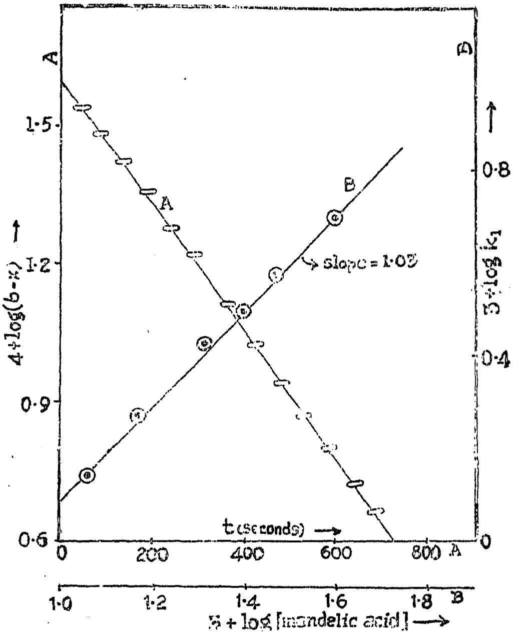


FIG. 1. A—First order plot, Solvent: 95% HOAc–5% H_2O (v/v), Temperature: 30° C; B—Log k_1 *vs.* log [mandelic acid], Solvent: 95% HOAc–5% H_2O (v/v), Temperature: 30° C.

The rate of disappearance of LTA was followed iodometrically,[3] using potassium iodide along with sodium acetate, the latter being added to keep back lead iodide in solution. Under the conditions of the experiments, the solvents were not oxidised[4] and the photochemical and thermal decompositions of LTA were found to be negligible.

The [illegible] solvent [illegible] [illegible] [illegible]

TABLE I

[Mandelic acid] = 0·0142 M; [LTA] = 0·0014 M
Temp. = 30° C

Solvent composition (% v/v)	$k_2 \times 10^{3}$ (litre mole^{-1} sec^{-1})
(a) HOAc–H_2O	
80:20	101·6
85:15	[illegible]
90:10	27·1
95:5	12·[illegible]
(b) HOAc–$C_6H_5NO_2$	
85:15	6·25
90:10	5·20
95:5	4·29
(c) HOAc–C_6H_6	
85:15	4·23
90:10	3·90
95:5	3·76

It is observed that increasing water content in the system increases the rate as is generally observed in LTA oxidations. For a variation of water content from 5 to 15% [illegible] but for the same range of variation of nitrobenzene content [illegible] and for benzene practically there is very little rate enhancement.

All other conditions remaining the same, the rate sequence for the three solvent systems at 30° C is: acetic acid–water > acetic acid–nitrobenzene > acetic acid–benzene. This is precisely the order of the dielectric constants of the solvents [illegible] 78·54, [illegible] 34·8, [illegible] 2·284. It is inferred that the increasing polarity of the solvent medium increases the transition state stabilisation by solvation and therefore the transition state is likely to be more polar than the reactants.

The rate data of the LTA oxidation of substituted mandelic acids reveals an interesting feature (Table II).

TABLE II

[Substrate] = 0·0014 M; [LTA] = 0·00035 M
Temp. = 30° C
Solvent 95% HOAc–5% H_2O; k_2 in litre mole^{-1} sec^{-1}

Substrate	$k_2 \times 10^{3}$
Mandelic acid	12·5
p-Fluoro mandelic acid	15·8
p-Chloro mandelic acid	17·0
p-Bromo mandelic acid	16·4

The [illegible] substituent effect is indicative of [illegible] free radical mechanism. The reaction is found to induce polymerization of acrylo nitrile also.

Dept. of Chemistry, K. [illegible]
Vivekananda [illegible]
College, N. VENKATASUBRAMANIAN.*
Mylapore, Madras-4,
February 19, 1970.

---

* To whom all correspondence may be addressed.

1. Criegee, R., *Angew. Chem.*, 1958, **70**, 173; *Ber.*, 1940, **73**, 563.
2. Bunton, C. A., *Oxidation in Organic Chemistry*, Edited by Wiberg, K. B., Academic Press, 1965, p. 402.
3. Turney, T. A., *Oxidation Mechanisms*, Butterworth Publication, London, 1965, p. 60.
4. Harvey, D. P. and Norman, R. O. C., *J. Chem. Soc.*, 1964, 88c, 1860.

A NEW GLUCOSIDE FROM *CLEISTANTHUS COLLINUS*

The roots, leaves and fruits of *Cleistanthus collinus* are well known for their physiological activity.[1] From the bark, leucodelphinidin,[2] [illegible], lupeol and β-sitosterol,[3] and from the leaves a toxic glucoside oduvin[4] were isolated. Govindachari and co-workers isolated diphyllin and collinusin,[5] two new lignan lactones from the leaves. A chemical investigation of the bark and leaves of the plant collected from [illegible] has now been taken up.

From the petroleum ether extract of the leaves of the plant a compound m.p. 85° has been isolated and identified as *n*-triacontanol through its acetate. The bark powder on extraction with petroleum ether yielded a compound m.p. 260°, mol. formula $C_{30}H_{50}O$, $[\alpha]_D$ 30°, oxime m.p. 290–292°. On direct comparison the compound was found to be identical with friedelin.[6]

Chloroform extract of the bark gave a crystalline compound A, m.p. 231–233°, I.R. data 3400 cm.$^{-1}$ (hydroxyl group), 1750 cm.$^{-1}$ (>C=O), 920 cm.$^{-1}$ (methylene dioxy group). U.V. data λ_{max}^{EtOH} 262, 297, 320 and 355 mμ (log ε 4·45, 3·43, 3·53 and 3·17), M$^+$ 542, $(\alpha)_D^{29}$ 16·2°, $C_{27}H_{26}O_{12}$ and its acetate m.p. 128°. Compound A on hydrolysis with 5% methanolic sulphuric acid furnished compound-B. Compound B has m.p. 289–290°, M$^+$ 380, $C_{21}H_{16}O_7$, I.R. data OH 3500 cm.$^{-1}$, >C=O 1710 cm.$^{-1}$, methylenedioxy 920 cm.$^{-1}$, and U.V. data λ_{max}^{EtOH} 231, 268, 295, 311, 360 mμ (log ε 4·43, 4·68, 4·01, 3·97 and 3·68), and acetyl derivative

expanded beam produces a speckle pattern superimposed on one another in the plane of the scattering surface which could be rotated. A camera lens of required aperture is used and the speckle pattern is photographed. After processing, the photographic plate is repositioned exactly in its original place. It is noticed that the repositioning of the plate is very critical and it could be accurately done by using a kinematically designed plate holder.

With the laser beams still on, and as we rotate the scattering surface and view through an imaging system focussed on to the photographic plate, we observe the fringe system. As rotation is continued the number of fringes is increased, and it is found that the number of fringes thus formed is proportional to the amount of rotation. It is further observed that for very high rotations the number is so increased that the fringe contrast is entirely lost. Hence, it may be said that this method is useful for small and moderate angular displacements. One such fringe system is shown in Fig. 2. Here ten fringes are observed for an angular rotation of the surface through two seconds of an arc. It is evident from the figure that the fringe contrast is quite good to facilitate the counting of the fringes.

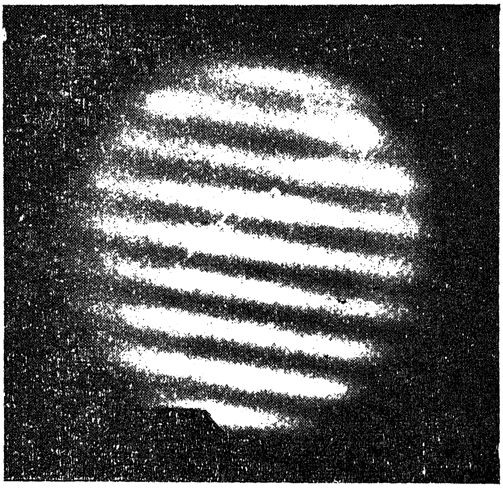


FIG. 2. Interference fringe system obtained on the rotation of a surface after repositioning the photographic plate.

This principle may also be conveniently applied to determine the twist produced on the surface of a body under torsion.

Dept. of Physics, V. VENKATESWARA RA
Regional Engg. College,
Warangal-4 (A.P.), *March* 30, 1970.

KINETICS OF OXIDATION OF MANDELIC ACID BY LEAD TETRAACETATE

THOUGH lead tetraacetate (LTA) is known t cleave α-hydroxy acids,[1,2] very little work ha been done on the kinetics of these oxidations We have now investigated the oxidation o mandelic acid and substituted mandelic acid in three binary solvent systems, namely, aceti acid-water, acetic acid-nitrobenzene, and aceti acid-benzene. The oxidation is totally of the second order being first with respect to the concentration of the hydroxy acid and also first with respect to tetravalent lead (Fig. 1).

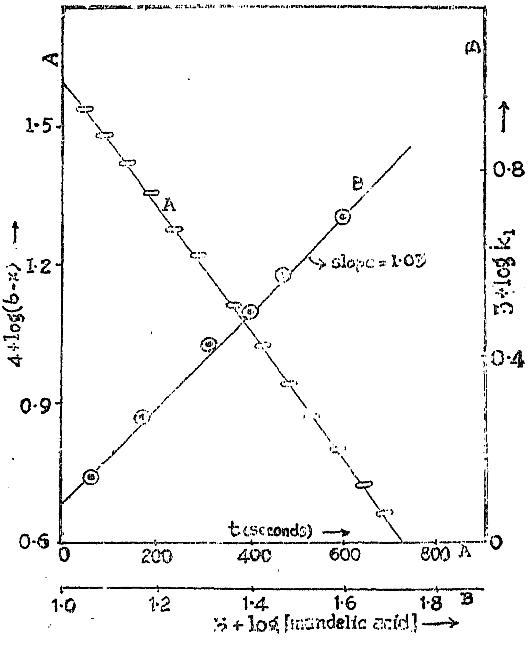


FIG. 1. A—First order plot, Solvent: 95% HOAc – 5% H_2O (v/v), Temperature: 30° C; B—Log k_1 *vs.* log [mandelic acid], Solvent: 95% HOAc – 5% H_2O (v/v), Temperature: 30° C.

The rate of disappearance of LTA was followed iodometrically,[3] using potassium iodide along with sodium acetate, the latter being added to keep back lead iodide in solution. Under the conditions of the experiments, the solvents were not oxidised[4] and the photochemical and thermal decompositions of LTA were found to be negligible.

The results of the influence of the solvent systems on the rate of oxidation summarised in Table I are particularly interesting.

TABLE I

[Mandelic acid] = 0·01427 M [LTA] = 0·004 M
Temp. 30° C.

Solvent composition (% v/v)	$k_2 \times 10^2$ litre mole^{-1} sec^{-1}
(*a*) $\mathrm{H\overline{OAc}}$—H_2O	
80-20	101·6
85-15	55·6
90-10	27·4
95- 5	12·5
(*b*) $\mathrm{H\overline{OAc}}$—$C_6H_5NO_2$	
85-15	6·35
90-10	5·30
95- 5	4·29
(*c*) $\mathrm{H\overline{OAc}}$—C_6H_6	
85-15	4·23
90-10	3·90
95- 5	3·76

It is observed that increasing water content in the system increases the rate as is generally observed in LTA oxidations. For a variation of water content (v/v) from 5% to 15% (I-a) the rate benefit is about five times; but for the same range of variation of nitrobenzene content (I-*b*), it is only 1·5 times and for benzene (I-c) practically there is very little rate enhancement.

All other conditions remaining the same, the rate sequence for the three solvent systems at 30° C. is acetic acid-water > acetic acid-nitrobenzene > acetic acid-benzene. This is precisely the order of the dielectric constants of the media also ($\epsilon_{\mathrm{H\overline{OAc}}} = 9 \cdot 7$; $\epsilon_{H_2O} = 78 \cdot 54$; $\epsilon_{C_6H_5NO_2} = 37 \cdot 8$; $\epsilon_{C_6H_6} = 2 \cdot 38$). It is inferred that the increasing polarity of the solvent medium increases the transition state stabilisation by solvation and therefore the transition state is likely to be more polar than the reactants.

The rate study of the LTA oxidation of substituted mandelic acids reveals an interesting feature (Table II).

TABLE II

[Substrate] = 0·014 M [LTA] = 0·0035 M
Temp.: 30° C.
Solvent: 95% HOAc–5% H_2O k_2 in litre mole^{-1} sec^{-1}

Substrate	$k_2 \times 10^2$
Mandelic acid	12·5
p-Fluoro mandelic acid	15·8
p-Chloro mandelic acid	17·0
p-Bromo mandelic acid	16·4

The scanty substituent effect is indicative of a free radical mechanism. The reaction is found to induce polymerisation of acrylo nitrile also.

Dept. of Chemistry, Vivekananda College, Mylapore, Madras-4,
K. SWAMINATHAN.
S. SUNDARAM.
N. VENKATASUBRAMANIAN.*

February 19, 1970.

---

* To whom all correspondence may be addressed.

1. Criegee, R., *Angew. Chem.*, 1958, **70**, 173; *Ber.*, 1940, **73**, 563.
2. Bunton, C. A., *Oxidation in Organic Chemistry*, Edited by Wiberg, K. B., Academic Press, 1965, p. 403.
3. Turney, T. A., *Oxidation Mechanisms*, Butterworth Publication, London, 1965, p. 60.
4. Harvey, D. R. and Norman, R. O. C., *J. Chem. Soc.*, 1964, **88c**, 4860.

A NEW GLUCOSIDE FROM *CLEISTANTHUS COLLINUS*

THE bark, leaves and fruits of *Cleistanthus collinus* are well known for their physiological activity.[1] From the bark, leucodelphinidin,[2] from the fruits, lupeol and β-sitosterol,[3] and from the leaves a toxic glucoside oduvin[4] were isolated. Govindachari and co-workers isolated diphyllin[5] and collinusin,[6] two new lignan lactones from the leaves. A chemical investigation of the bark and leaves of the plant collected from Pakal has now been taken up.

From the petroleum ether extract of the leaves of the plant a compound m.p. 85° has been isolated and identified as *n*-triacontanol through its acetate. The bark powder on extraction from petroleum ether yielded a compound m.p. 260°, mol. formula $C_{30}H_{50}O$, $(\alpha)_D^{26}$ –30°, oxime m.p. 290–292°. On direct comparison, the compound was found to be identical with friedelin.[7]

Chloroform extract of the bark gave a crystalline compound-A m.p. 231–233°, I.R. data 3500 cm.$^{-1}$ (hydroxyl group), 1750 cm.$^{-1}$ (> C=O), 920 cm.$^{-1}$ (methylene dioxy group). U.V. data $\lambda_{\max}^{\mathrm{EtOH}}$ 262, 297, 320 and 355 mμ (log ϵ 4·45, 3·43, 3·73 and 3·17), M^+ 542, $(\alpha)_D^{29}$ –16·2° $C_{27}H_{26}O_{12}$, and its acetate m.p. 128°. Compound-A on hydrolysis with 5% methanolic sulphuric acid furnished compound-B. Compound-B has m.p. 289–290°, M^+ 380, $C_{21}H_{16}O_7$, I.R. data –OH 3500 cm.$^{-1}$, > C=O 1710 cm.$^{-1}$, methylenedioxy 920 cm.$^{-1}$, and U.V. data $\gamma_{\max}^{\mathrm{EtOH}}$ 231, 268, 295, 311, 360 mμ (log ϵ 4·43, 4·68, 4·01, 3·97 and 3·68), and acetyl derivative

expanded beam produces a speckle pattern superimposed on one another in the plane of the scattering surface which could be rotated. A camera lens of required aperture is used and the speckle pattern is photographed. After processing, the photographic plate is repositioned exactly in its original place. It is noticed that the repositioning of the plate is very critical and it could be accurately done by using a kinematically designed plate holder.

With the laser beams still on, and as we rotate the scattering surface and view through an imaging system focussed on to the photographic plate, we observe the fringe system. As rotation is continued the number of fringes is increased, and it is found that the number of fringes thus formed is proportional to the amount of rotation. It is further observed that for very high rotations the number is so increased that the fringe contrast is entirely lost. Hence, it may be said that this method is useful for small and moderate angular displacements. One such fringe system is shown in Fig. 2. Here ten fringes are observed for an angular rotation of the surface through two seconds of an arc. It is evident from the figure that the fringe contrast is quite good to facilitate the counting of the fringes.

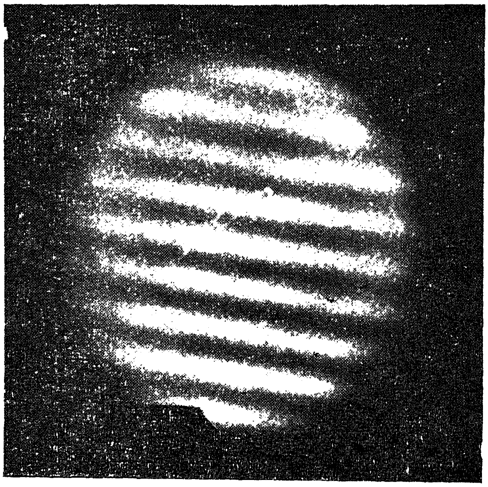


FIG. 2. Interference fringe system obtained on the rotation of a surface after repositioning the photographic plate.

This principle may also be conveniently applied to determine the twist produced on the surface of a body under torsion.

Dept. of Physics, V. VENKATESWARA RAO.
Regional Engg. College,
Warangal-4 (A.P.), *March* 30, 1970.

KINETICS OF OXIDATION OF MANDELIC ACID BY LEAD TETRAACETATE

THOUGH lead tetraacetate (LTA) is known to cleave α-hydroxy acids,[1,2] very little work has been done on the kinetics of these oxidations. We have now investigated the oxidation of mandelic acid and substituted mandelic acids in three binary solvent systems, namely, acetic acid-water, acetic acid-nitrobenzene, and acetic acid-benzene. The oxidation is totally of the second order being first with respect to the concentration of the hydroxy acid and also first with respect to tetravalent lead (Fig. 1).

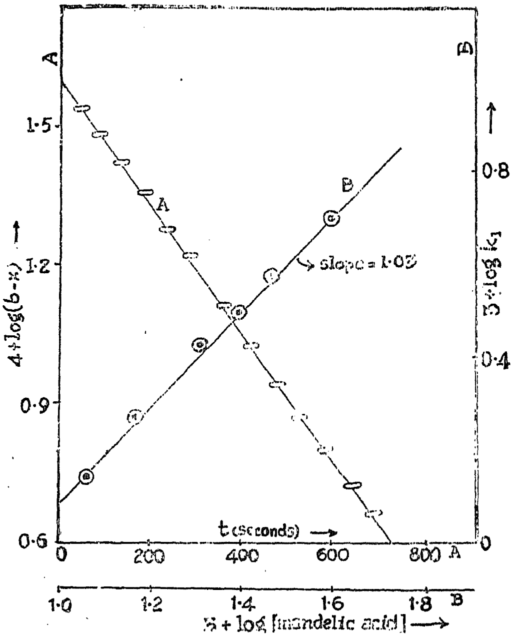


FIG. 1. A—First order plot, Solvent: 95% HOAc–5% H_2O (*v/v*), Temperature: 30° C; B—Log k_1 *vs.* log [mandelic acid], Solvent: 95% HOAc–5% H_2O (*v/v*), Temperature: 30° C.

The rate of disappearance of LTA was followed iodometrically,[3] using potassium iodide along with sodium acetate, the latter being added to keep back lead iodide in solution. Under the conditions of the experiments, the solvents were not oxidised[4] and the photochemical and thermal decompositions of LTA were found to be negligible.

The [illegible] of the [illegible] of the solvent [illegible] the rate of oxidation summarised [illegible] are particularly interesting.

TABLE I

[Mandelic acid] = 0·0142 M [LTA] = 0·004 M
Temp. 30° C.

Solvent composition (%)	$k_2 \times 10^3$ litre mole⁻¹ sec⁻¹
(a) HOAc–H$_2$O	
80 : 20	101·6
85 : 15	[illegible]·6
90 : 10	27·4
95 : 5	12·[illegible]
(b) HOAc–C$_6$H$_5$NO$_2$	
85 : 15	6·35
90 : 10	5·30
95 : 5	4·29
(c) HOAc–C$_6$H$_6$	
85 : 15	4·23
90 : 10	3·90
95 : 5	3·76

It is observed that increasing water content in the system increases the rate as is generally observed in LTA oxidations. For a variation of water content from [illegible] to 15% [illegible] the rate increases [illegible] times, but for the same range of variation of nitrobenzene content it is only 1·5 times and for benzene also practically there is very little rate enhancement.

All other conditions remaining the same, the rate sequence for the three solvent systems at 30° C is acetic acid–water > acetic acid–nitrobenzene > acetic acid–benzene. This is precisely the order of the dielectric constants of the [illegible] 9·7, [illegible] 78·54, [illegible] 2·28). It is inferred that the increasing polarity of the solvent medium increases the transition state stabilisation by solvation and therefore the transition state is likely to be more polar than the reactants.

The rate studies of the LTA oxidation of substituted mandelic acids reveal an interesting feature (Table II).

TABLE II

[Substrate] = 0·0014 M [LTA] = 0·0035 M
Temp. = 30° C.
Solvent = 95% HOAc–5% H$_2$O; k_2 in litre mole⁻¹ sec⁻¹

Substrate	$k_2 \times 10$
Mandelic acid	12·6
p-Fluoro mandelic acid	15·8
p-Chloro mandelic acid	17·0
p-Bromo mandelic acid	10·4

The [illegible] substituent effect is indicative of a free radical mechanism. The reaction is found to induce polymerisation of acrylo nitrile also.

Dept. of Chemistry, K. SWAMINATHAN.
Vivekananda S. SUNDARAM.
College, N. VENKATASUBRAMANIAN.*
Mylapore, Madras-4,
February 19, 1970.

---

* To whom all correspondence may be addressed.

1. Criegee, R., *Angew. Chem.*, 1958, **70**, 173; *Ber.*, 1940, **73**, 563.
2. Bunton, C. A., *Oxidation in Organic Chemistry*, Edited by Wiberg, K. B., Academic Press, 1965, p. 402.
3. Turney, T. A., *Oxidation Mechanisms*, Butterworth Publication, London, 1965, p. 60.
4. Harvey, D. R. and Norman, R. O. C., *J. Chem. Soc.*, 1964, **88c**, 4860.

A NEW GLUCOSIDE FROM *CLEISTANTHUS COLLINUS*

The bark, leaves and fruits of *Cleistanthus collinus* are well known for their physiological activity.[1] From the bark, leucodelphinidin,[2] from the fruits, lupeol and β-sitosterol,[3] and from the leaves a toxic glucoside oduvin[4] were isolated. Govindachari and co-workers isolated diphyllin[5] and collinusin,[6] two new lignan lactones from the leaves. A chemical investigation on the bark and leaves of the plant collected from Pakal has now been taken up.

From the petroleum ether extract of the leaves of the plant a compound m.p. 85° has been isolated and identified as *n*-triacontanol through its acetate. The bark powder on extraction from petroleum ether yielded a compound m.p. 260°, mol. formula $C_{30}H_{50}O$, $(\alpha)_D^{29}$ 30°, oxime m.p. 290–292°. On direct comparison, the compound was found to be identical with friedelin.[7]

Chloroform extract of the bark gave a crystalline compound-A m.p. 231–233°, I.R. data 3500 cm.⁻¹ (hydroxyl group), 1750 cm.⁻¹ (>C=O), 920 cm.⁻¹ (methylene dioxy group). U.V. data λ_{max}^{EtOH} 262, 297, 320 and 355 mμ (log ε 4·45, 3·43, 3·73 and 3·17), M⁺ 542, $(\alpha)_D^{29}$ 16·2°, $C_{27}H_{26}O_{12}$ and its acetate m.p. 128°. Compound-A on hydrolysis with 5% methanolic sulphuric acid furnished compound-B. Compound-B has m.p. 289–290°, M⁺ 380, $C_{21}H_{16}O_7$, I.R. data OH 3500 cm.⁻¹, >C=O 1710 cm.⁻¹, methylenedioxy 920 cm.⁻¹, and U.V. data λ_{max}^{EtOH} 231, 268, 295, 311, 360 mμ (log ε 4·43, 4·68, 4·01, 3·97 and 3·68), and acetyl derivative

expanded beam produces a speckle pattern superimposed on one another in the plane of the scattering surface which could be rotated. A camera lens of required aperture is used and the speckle pattern is photographed. After processing, the photographic plate is repositioned exactly in its original place. It is noticed that the repositioning of the plate is very critical and it could be accurately done by using a kinematically designed plate holder.

With the laser beams still on, and as we rotate the scattering surface and view through an imaging system focussed on to the photographic plate, we observe the fringe system. As rotation is continued the number of fringes is increased, and it is found that the number of fringes thus formed is proportional to the amount of rotation. It is further observed that for very high rotations the number is so increased that the fringe contrast is entirely lost. Hence, it may be said that this method is useful for small and moderate angular displacements. One such fringe system is shown in Fig. 2. Here ten fringes are observed for an angular rotation of the surface through two seconds of an arc. It is evident from the figure that the fringe contrast is quite good to facilitate the counting of the fringes.

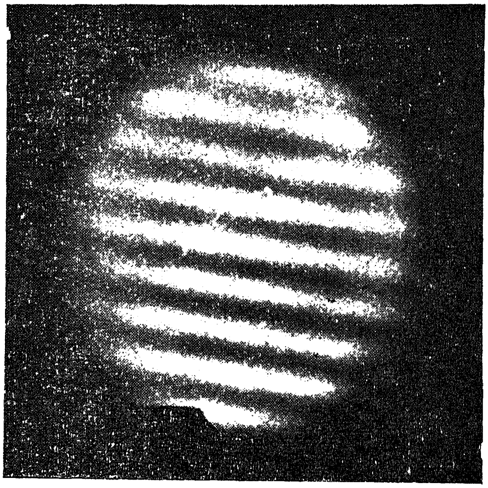


FIG. 2. Interference fringe system obtained on the rotation of a surface after repositioning the photographic plate.

This principle may also be conveniently applied to determine the twist produced on the surface of a body under torsion.

Dept. of Physics, V. VENKATESWARA RAO.
Regional Engg. College,
Warangal-4 (A.P.), *March* 30, 1970.

KINETICS OF OXIDATION OF MANDELIC ACID BY LEAD TETRAACETATE

THOUGH lead tetraacetate (LTA) is known to cleave α-hydroxy acids,[1,2] very little work has been done on the kinetics of these oxidations. We have now investigated the oxidation of mandelic acid and substituted mandelic acids in three binary solvent systems, namely, acetic acid-water, acetic acid-nitrobenzene, and acetic acid-benzene. The oxidation is totally of the second order being first with respect to the concentration of the hydroxy acid and also first with respect to tetravalent lead (Fig. 1).

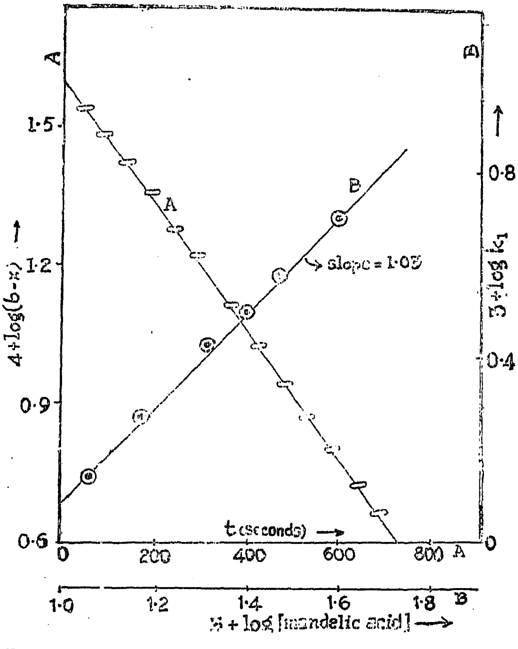


FIG. 1. A—First order plot, Solvent: 95% $\overline{\text{HOAc}}$—5% H_2O (v/v), Temperature: 30° C; B—Log k_1 *vs.* log [mandelic acid], Solvent: 95% HOAc—5% H_2O (v/v), Temperature: 30° C.

The rate of disappearance of LTA was followed iodometrically,[3] using potassium iodide along with sodium acetate, the latter being added to keep back lead iodide in solution. Under the conditions of the experiments, the solvents were not oxidised[4] and the photochemical and thermal decompositions of LTA were found to be negligible.

The results of the influence of the solvent systems on the rate of oxidation summarised in Table I are particularly interesting.

TABLE I

[Mandelic acid] = 0·01427 M [LTA] = 0·004 M
Temp. 30° C.

Solvent composition (% v/v)	$k_2 \times 10^2$ litre mole^{-1} sec^{-1}
(*a*) $\overline{HOAc}$—H_2O	
80-20	101·6
85-15	55·6
90-10	27·4
95- 5	12·5
(*b*) $\overline{HOAc}$—$C_6H_5NO_2$	
85-15	6·35
90-10	5·30
95- 5	4·29
(*c*) $\overline{HOAc}$—C_6H_6	
85-15	4·23
90-10	3·90
95- 5	3·76

It is observed that increasing water content in the system increases the rate as is generally observed in LTA oxidations. For a variation of water content (v/v) from 5% to 15% (I-a) the rate benefit is about five times; but for the same range of variation of nitrobenzene content (I-b), it is only 1·5 times and for benzene (I-c) practically there is very little rate enhancement.

All other conditions remaining the same, the rate sequence for the three solvent systems at 30° C. is acetic acid-water > acetic acid-nitrobenzene > acetic acid-benzene. This is precisely the order of the dielectric constants of the media also ($\epsilon_{\overline{HOAc}} = 9 \cdot 7$; $\epsilon_{H_2O} = 78 \cdot 54$; $\epsilon_{C_6H_5NO_2} = 37 \cdot 8$; $\epsilon_{C_6H_6} = 2 \cdot 38$). It is inferred that the increasing polarity of the solvent medium increases the transition state stabilisation by solvation and therefore the transition state is likely to be more polar than the reactants.

The rate study of the LTA oxidation of substituted mandelic acids reveals an interesting feature (Table II).

TABLE II

[Substrate] = 0·014 M [LTA] = 0·0035 M
Temp.: 30°C.
Solvent: 95% HOAc – 5% H_2O k_2 in litre mole^{-1} sec^{-1}

Substrate	$k_2 \times 10^2$
Mandelic acid	12·5
p-Fluoro mandelic acid	15·8
p-Chloro mandelic acid	17·0
p-Bromo mandelic acid	16·4

The scanty substituent effect is indicative of a free radical mechanism. The reaction is found to induce polymerisation of acrylo nitrile also.

Dept. of Chemistry, K. SWAMINATHAN.
Vivekananda S. SUNDARAM.
College, N. VENKATASUBRAMANIAN.*
Mylapore, Madras-4,
February 19, 1970.

---

* To whom all correspondence may be addressed.

1. Criegee, R., *Angew. Chem.*, 1958, **70**, 173; *Ber.*, 1940, **73**, 563.
2. Bunton, C. A., *Oxidation in Organic Chemistry*, Edited by Wiberg, K. B., Academic Press, 1965, p. 403.
3. Turney, T. A., *Oxidation Mechanisms*, Butterworth Publication, London, 1965, p. 60.
4. Harvey, D. R. and Norman, R. O. C., *J. Chem. Soc.*, 1964, **88c**, 4860.

A NEW GLUCOSIDE FROM *CLEISTANTHUS COLLINUS*

THE bark, leaves and fruits of *Cleistanthus collinus* are well known for their physiological activity.[1] From the bark, leucodelphinidin,[2] from the fruits, lupeol and β-sitosterol,[3] and from the leaves a toxic glucoside oduvin[4] were isolated. Govindachari and co-workers isolated diphyllin[5] and collinusin,[6] two new lignan lactones from the leaves. A chemical investigation of the bark and leaves of the plant collected from Pakal has now been taken up.

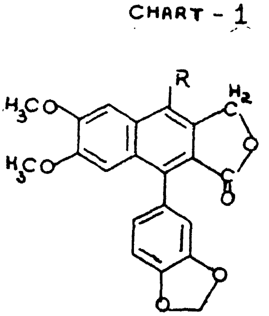
From the petroleum ether extract of the leaves of the plant a compound m.p. 85° has been isolated and identified as *n*-triacontanol through its acetate. The bark powder on extraction from petroleum ether yielded a compound m.p. 260°, mol. formula $C_{30}H_{50}O$, $(\alpha)_D^{26}$ –30°, oxime m.p. 290–292°. On direct comparison, the compound was found to be identical with friedelin.[7]

Chloroform extract of the bark gave a crystalline compound-A m.p. 231–233°, I.R. data 3500 cm.$^{-1}$ (hydroxyl group), 1750 cm.$^{-1}$ (>C=O), 920 cm.$^{-1}$ (methylene dioxy group). U.V. data λ_{max}^{EtOH} 262, 297, 320 and 355 mμ (log ε 4·45, 3·43, 3·73 and 3·17), M$^+$ 542, $(\alpha)_D^{29}$ –16·2° $C_{27}H_{26}O_{12}$, and its acetate m.p. 128°. Compound-A on hydrolysis with 5% methanolic sulphuric acid furnished compound-B. Compound-B has m.p. 289–290°, M$^+$ 380, $C_{21}H_{16}O_7$, I.R. data –OH 3500 cm.$^{-1}$, >C=O 1710 cm.$^{-1}$, methylenedioxy 920 cm.$^{-1}$, and U.V. data γ_{max}^{EtOH} 231, 268, 295, 311, 360 mμ (log ε 4·43, 4·68, 4·01, 3·97 and 3·68), and acetyl derivative m.p. 231°, methyl ether m.p. 263°. The methyl ether of compound-B is found to be identical in all respects with Justicidin-A[8] (I *b* ; R $=OCH_3$) an extractive of *Justicia hayati.* Compound-B and its acetate are identical with diphyllin (I *a* ; R = OH) and its acetate in all respects.

After hydrolysis of compound-A with 5% methanolic sulphuric acid, the mother liquor was examined for sugars by paper chromatography using butanol-acetic acid-water (4 : 1 : 5) and ethyl acetate-butanol-water (1 : 4 : 5) and aniline hydrogen phthalate for development of colour. The presence of glucose (R_f 0·178 in B/A/W and co-chromatography with an authentic specimen of β-D-glucose) is inferred. Thus compound-A is diphyllin-O-Glucoside. Its molecular weight is in agreement with a mono glucoside rather than a diglucoside. In a preliminary report[10] this substance was named as cleistanthin.

For further support, a partial synthesis of compound-A has been achieved. Diphyllin was refluxed with α-acetobromoglucose in dry acetone and potassium carbonate for ten hours. The compound obtained was found to be identical in all respects with the acetyl derivative of compound-A. Thus the compound-A has the assigned structure diphyllin-O-glucoside (I *d* ; R=O-Glucose). Recently, a glycoside by name cleistanthin was reported by Govindachari and co-workers.[11] On comparison with their compound, diphyllin-O-Glucoside is found to be different. Since they have named their substance also as cleistanthin (I c ; R=3, 4, di-O-methyl-D-xylose), we propose that their compound be named as cleistanthin-A and the compound reported in this paper as cleistanthin-B.

CHART - 1



I *a* ; R=OH ; Diphyllin.
I *b* ; R$=OCH_3$: Justicidin A.
I *c* ; R=3, 4 Di-O-methyl-D-xylose; Cleistanthin A.
I *d* ; R=-O-glucose, Cleiastanthin B,

The authors are thankful to Prof. L. R. Row, for a specimen of friedelin and to Dr. Govindachari, for sending the samples of diphyllin, diphyllin acetate, and cleistanthin-A. One of the authors (TGL) is grateful to CSIR, for the award of a Junior Research Fellowship.

Dept. of Chemistry, (Mrs.) T. G. Lakshmi.
Osmania University, G. Srimannarayana.
Hyderabad-7, N. V. Subba Rao.
March 16, 1970.

1. Chopra, R. N., Badhwar, R. L. and Ghosh, S., *Poisonous Plants of India*, Indian Council of Agricultural Research, New Delhi, 1965, **2**, 774.
2. Ganguly, A. K., Seshadri, T. R. and Subramanian, P. R., *Tetrahedron*, 1958, **3**, 225.
3. Maiti, P. C. and Das, A. K., *Curr. Sci.*, 1965, **34**, 179.
4. Rajagopal Naidu, S., Venkat Rao, P. and Subramaniam, C. A.. *Jour. Proc. Inst. Chemists (India)*, 1944, **16**, 59.
5. Govindachari, T. R., Sathe, S. S., Viswanathan, N., Pai, B. R. and Srinivasan, M., *Tetrahedron Letters*, 1967, **36**, 3517.
6. —, — and —, *Ibid.*, 1967, **42**, 4183.
7. Karrer, W., *Kostitution and Vorkinen der Organischem pflanzenstoffe* (Birkhüser verlog & stuttgart), 1958.
8. Munakata, K., Marumo, S., Ohta, K. and Chen, Y. L., *Tetrahedron letters*, 1965, **47**, 4167.
9. Murakami, T. R. and Matsushima, A., *J. Pharm. Soc.*, (Japan), 1961, **81**, 1956.
10. Subba Rao, N. V., "Chemical Investigation of some Indian insecticidal and fish poisonous plants," *A Paper Presented at the Indo-Soviet Symposium Held at Tashkent, U.S.S.R.*, September, 1968.
11. Govindachari, T. R., Sathe, S. S., Viswanathan, N., Pai, B. R. and Srinivasan, M., *Tetrahedron*, 1969, **25**, 2815.

PHASE STUDIES IN THE SYSTEM $FeNb_2O_6$-$YNbTiO_6$

The structural properties of Columbite[1-3] and Euxenite[4-6] have been investigated by many workers ; but the phase studies of the present system and the relation between Columbite and Euxenite have not been reported in the literature.

All the samples were prepared by mixing the appropriate quantities of the component oxides and fired at 1200° C. for twenty hours and 1350° C. for three hours in air. Finally, the samples were quenched to room temperature. The samples thus obtained were analysed by X-ray diffraction techniques using 14 cm. diameter Debye-Scherrer Camera and Fe K_α radiation, filtered through Zr foil, The results are given in Table I,

TABLE I

The system $FeNb_2O_6$-$YNbTiO_6$

Serial No.	Composition	Molecular weight	Colour	Density	Phases present
1	$Y_{0\cdot 2}Fe_{1\cdot 8}Ti_{0\cdot 45}Nb_{3\cdot 6}O_{12}$	667·0	Steel grey	3·45	Columbite + Euxenite *a* = 4·779 ; *b* = 14·72; *c* = 5·344 Å
2	$Y_{0\cdot 4}Fe_{1\cdot 6}Ti_{1\cdot 15}Nb_3O_{12}$	651·4	Steel grey	3·69	Columbite + Euxenite *a* = 5·351 ; *b* = 14·70 ; *c* = 5·321 Å
3	$Y_{0\cdot 6}Fe_{1\cdot 4}Ti_{1\cdot 35}Nb_{2\cdot 8}O_{12}$	649·0	Grey	4·31	Euxenite *a* = 5·520 ; *b* = 14·68 ; *c* = 5·314 Å
4	$Y_{0\cdot 8}Fe_{1\cdot 2}Ti_{1\cdot 8}Nb_{2\cdot 4}O_{12}$	640·0	Grey	4·59	Euxenite *a* = 5·520 ; *b* = 14·65 ; *c* = 5·278 Å
5	$Y_2Ti_2Nb_2O_{12}$	652·0	White	4·64	Euxenite *a* = 5·520 ; *b* = 14·57 ; *c* = 5·166 Å

Table I shows that on introduction of even 10% Y^{3+} in the A site, the euxenite phase appears, though the lines due to euxenite were very faint. On introduction of more Y^{3+} the euxenite phase was predominant and in the composition No. 3, the columbite phase completely disappeared.

From ionic consideration it is expected that, introduction of Y^{3+} (0·92 Å) for Fe^{2+} (0·74 Å) in A sites and Ti^{4+} (0·68 Å) for Nb^{5+} (0·69 Å) in the B sites, will have predominant effect on columbite lattice and the lattice parameters would increase. But Table I shows that the lattice parameters decrease. On examining the structure of columbite, it is observed that the MO_6 octahedra are arranged in chains ranged along the a_0 axis and held together by sharing edges, on changing to euxenite the MO_6 octahedra chains break and rearrange themselves to a close-packed arrangement, thereby causing slight decrease in the lattice dimensions which is in accordance with the present observations.

Dept. of Inorganic and
Structural Chemistry,
College of Science,
Nagpur, *March* 9, 1970.

K. P. RAMAN.
M. P. TARE.
D. M. JOSHI.
K. RAMA RAO.

---

1. Tavora, *Anais Acad. Brasileira Cienc*, 1955, **27**, 18.
2. Osborne Hutton, C., *Am. Min.*, 1959, **44**, 8.
3. Rama Rao, K. and Deshpande, V. V., *Chem. Comm.*, 1968, **22**, 1418.
4. Arnott, R. J., *Amer. Min.*, 1950, **35**, 386.
5. Alexandrov, V. B. and Pytenko, Yu. A., *Doklady Akad. Nauk. S.S.R.*, 1959, **124**, 179.
6. Rama Rao, K. and Deshpande, V. V., *Curr. Sci.*, 1968, **23**, 668.

TRACHEAL PULSATION IN A MARINE CENTIPEDE *MIXOPHILUS INDICUS*

IT is well known that marine centipedes are capable of enduring submergence in water for several days and when re-admitted to aerial respiration, the oxygen debt is cleared off in a matter of a few hours by a remarkable increase in the rate of consumption of oxygen.[1,2] This would involve an efficient tracheal ventilatory mechanism to draw in a large volume of air into the tracheal system. As a result of extensive studies Chalande[3] concluded that the tracheal ventilatory mechanism in marine centipedes might be of a type different from what is commonly known for insects. But no attention has so far been paid to this aspect of respiratory physiology in these terrestrial arthropods which are secondarily adapted for aquatic life.

Incidental to a recent study on the respiration of a marine centipede *Mixophilus indicus*,[2] the centipedes re-admitted to aerial respiration after submergence in water, were examined under a binocular microscope to determine whether there were any external movements of contraction either transverse or longitudinal or of the rings upon one another. The result was negative suggesting that the ventilatory movement, if any, was only internal.

Therefore, a part of the tergite of a trunk segment of an alive animal was removed and the viscera examined. Centipede-saline of the composition given elsewhere[4] was used for perfusion. This procedure disclosed that the main longitudinal tracheal trunks were rhythmically contracting and expanding. Recordings of such pulsatory movements of the tracheal trunks were made on a physiograph pen recorder using an isometric myograph attached by a fine thread to a longitudinal tracheal trunk. The recordings suggest that the maximum number of such pulsatile movements is 22 to 25 per minute (Fig. 1) in an individual taken out of water after submergence for a period of 3 days. If the period of immersion in water is shortened, the rate of pulsatile movements of the tracheal trunks is also lowered. During normal respiration in an individual which is not previously subjected to submergence in water, the rate of tracheal pulsation is only 3 to 5 per minute.

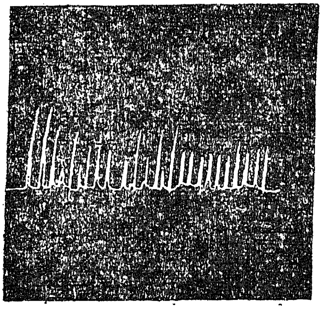


FIG. 1. An extract from a recording of the tracheal pulsations of *Mixophilus indicus*. The time for the recording shown in the figure is one minute.

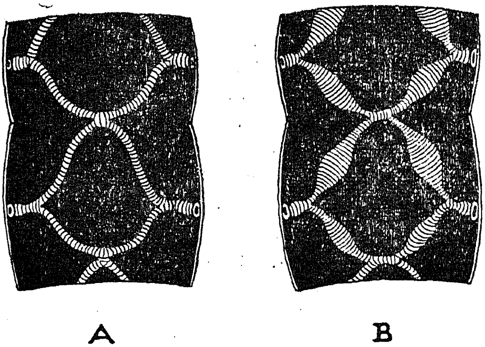


FIG. 2. Tracheal trunks in two segments of the centipedes (semi-diagrammatic). A, *Himantarium samuelraji*; B, *Mixophilus indicus*.

An attempt was made to find out whether such tracheal pulsations are of common occurrence in typical terrestrial centipedes also. For this purpose, a number of alive geophilid centipedes of the species *Himantarium samuelraji*, collected from Alagar Koil forest region, were dissected and their tracheal trunks examined as described above. In none of the 10 centipedes examined were the tracheal pulsations observed.

Another feature discovered was that the longitudinal tracheal trunks in the two centipedes show structural differences. In *Mixophilus indicus* the middle regions of the longitudinal trunks are much swollen resembling the air-sacs found in locusts.[5] But in *Himantarium samuelraji* all the tracheal trunks are narrow tubes of uniform diameter (Fig. 2). It is suggested, therefore, that the presence of swollen longitudinal tracheal trunks capable of contraction and expansion in *Mixophilus indicus* may be a feature of adaptation in relation to its semi-aquatic mode of life.

A search in the literature for a precedent discloses that a comparable phenomenon was seen by Babak[6] in mosquito larvæ.

The author is grateful to Professor G. Krishnan for helpful suggestions and provision of facilities. Mr. G. Santhanakrishnan helped very much in the collection of centipedes.

Zoology Department, G. SUNDARA RAJULU.
University of Madras,
Madras, *February* 20, 1970.

---

1. Plateau, F., *Arch. Sci. Phys. et Nat.*, 1894, **25**, 132.
2. Sundara Rajulu, G., *Proc. Symp. Est. Biol.*, 1969, p. **1**.
3. Chalande, M. J., *Bull. Soc. Hist. Nat.*, 1887, **20**, 13.
4. Sundara Rajulu, G., *J. Anim. Morph. Physiol.*, 1966, **13**, 114.
5. McCutcheon, F. H., *Ann. Ent. Soc. Amer.*, 1940, **33**, 35.
6. Babak, E., *Int. Rev. Hydrobiol.*, 1912, **5**, 89.

ON THE OCCURRENCE AND DISTRIBUTION OF PHOSPHOBACTERIA IN THE MARINE ENVIRONMENT AT PORTO NOVO

IT is well known that the majority of the phosphates in soil are present as insoluble organic and inorganic phosphates. The phosphorus cycle in inland natural waters and bottom deposits is known to be a limiting factor in organic production.

Cooper[1] has shown that in the marine environment phosphate liberation from plankton occurred and suggested that this might be brought about by bacteria capable of dissolving phosphate from phosphorus-containing substance in solution. He did not, however, isolate and culture these organisms.

Several reports are available on the role of phosphobacteria in soil.[2,3] But no such work is available for the marine environment either in temperate or tropical regions. The present note reports the definite occurrence and distribution of phosphobacteria in the marine environment.

The samples were taken from four different zones in the marine environment as shown in Table I. They were taken in sterile glass bottles. Serial dilutions were prepared and plated on special soil-extract apatite agar[1] (the medium containing precipitated calcium phosphate). The media were prepared in sea-water with appropriate salinity. The plates were incubated at room temperature (24 ± 2° C.) for 3 days and observed. Clear solubilization zones around phosphobacteria colonies were seen in all the samples (Fig. 1). The total and phosphate solubilizing colonies were counted and their population was estimated.

TABLE I

Sl. No.	Sample	Locality	Depth	Bacterial population (10^6)	
				Total	Phospho-bacteria
1	Water	Interstitial Open sandy beach	95 cm.	6·53/L	4·96/L
2	Water	Estuary	Surface	6·86/L	5·72/L
3	Water	Neritic	Surface	5·96/L	5·20/L
4	Mud	Sea	10 fathom	7·66/g.	6·96/g.

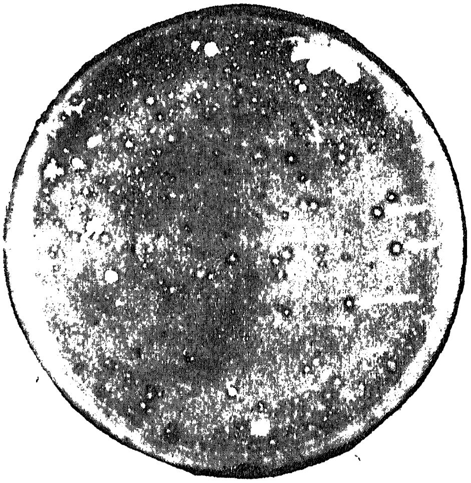


FIG. 1. Phosphobacteria in the interstitial waters. Arrows indicate the phosphobacterial colonies with clear surrounding solubilization zones.

From all the four samples, seven morphologically different phosphobacteria were isolated and purified. Five of them can be grouped under *Bacillus* spp. and the remaining two isolates are gram-negative, non-motile, non-spore-forming rods. It is interesting to note that the interstitial water harboured as many as five different groups. The estuarine water and neritic waters and the mud at 10 fathom line showed only three and two groups respectively. The different isolates varied in the degree of their ability to solubilize the inorganic insoluble phosphate as indicated by the clear solubilization zones. In general, *Bacillus* spp. were found to be more potent in their activity than the two gram-negative isolates. The effect of isolates from the neritic waters and the mud at 10 fathom was relatively higher than that of the estuarine and interstitial waters.

We thank Prof. R. V. Seshaiya, Director, for guidance and critical reading of the manuscript.

Centre of Advanced Study
in Marine Biology,
Marine Biological Station,
Porto Novo, South India, *March* 24, 1970.

K. AYYAKKANNU.
D. CHANDRAMOHAN.

---

1. Cooper, L. H. N., *J. Mar. Biol. Ass. U. K.*, 1935 *b*, **20**, 197.
2. Sen, A., *Curr. Sci.*, 1957, **26**, 222.
3. Katznelson, H. and Bose, B., *Canad. J. Microbiol.*, 1959, **5**, 79.
4. Sperber, J. L., *Aust. J. Agr. Res.*, 1958, **9**, 777.

PARTIAL LIFE-CYCLE OF A PHYSALOPTERID NEMATODE PARASITIC IN THE STOMACH OF CARNIVORES

NUMEROUS species named under *Physaloptera* Rudolphi, 1819 have been grouped, on the number of uteri—whether two, three, four or many, into four subgenera.[19] Among the species with two uteri in female, *P. præputialis* von Linstow, 1889; *P. brevispiculum* von Linstow, 1906; *P. füelleborni* Mirza and Singh, 1934; and *P. rara* Hall and Wigdor, 1918 have been recorded in our dog, cat, and wild carnivores.[3,4,9,18] Recently, *P. vulpineus* Gupta and Pande, 1963 was described from *Vulpes bengalensis*.[9]

Because of their robust form and the blood-sucking feeding habits, *P. præputialis*, *P. felidis* Ackert, 1936 and *P.* spp. (Ehlers, 1931) are incriminated in ulceration and catarrhal gastritis which, in heavy infections in cat and badger, result in a marked loss of condition.[16]

In spite of their wide prevalence, information on life-cycles and the vectors is comparatively meagre though encysted larval forms have been reported from *Bufo stomaticus*[17]; bob white quail[6]; *Sciurus palmarum*[12]; ruffed grouse[5,6]; *Hemidactylus flaviviridis*[11]; an earwig, *Labidura reparia*[2]; quail, *Colinus virginianus*[7]; and *Uromastix hardwickii.*[8]

Observations on larval development and life-cycles are available for *P. turgida* Rudolphi, 1819[1]; *P. maxillaris* Molin, 1860[10]; *P. rara*[13,14]; *P. prœputialis*[14,20,21]; and *P. hispida* Schell, 1950.[15] The intermediate or/and paratenic hosts for the encysted physalopterid larvæ, so far reported from Indian region, are: *B. stomaticus, S. palmarum, H. flaviviridis, L. reparia* and *U. hardwickii.*

Numerous specimens of the larvæ found encapsulated in the muscles and the mesentery of the spiny-tailed lizard were fed to laboratory-reared kittens (4), pups (18), chick (1) and laboratory-bred rabbits (3), white albino mice (2) and white albino rats (5) to determine their specific identity. Different stages of the developing juveniles were recovered, on autopses conducted at intervals, from the infected pups. The two cats, slaughtered on the 20th and 90th day of the infection, yielded fourth-stage juveniles and adults. 2 rabbits and 2 rats, however, yielded re-encysted larvæ from the gastric wall and the mesentery, the other infected animals were found to be negative.

From a detailed study of the live and the fixed specimens (cleared in 70% alcohol-glycerine or lactophenol), the material was determined as belonging to *P. brevispiculum.* The size-ranges were within those given for this species by Baylis (1939). The present findings on the mammalian phase of the life-cycle, *i.e.*, the development of infective larvæ, collected from a paratenic host, to maturity adds to the list of the life-cycles so far known for *P. turgida, P. maxillaris, P. rara, P. prœputialis,* and *P. hispida* in which, however, the intermediate hosts used for experimentation were arthropods. Detailed account of the stages in development is being published elsewhere.

Grateful acknowledgement is due to the Indian Council of Agricultural Research for the award of Senior Research Fellowship in Helminthology (to V. P. G.) and to the Principal of the College for facilities provided.

Dept. of Parasitology, V. P. GUPTA.
U.P. College of Veterinary B. P. PANDE.
Science and Animal Husbandry,
Mathura (U.P.), *February* 13, 1970.

---

1. Alicata, J. E., *Rabot, Gel'mint.* (Skrjabin), 1937, **11.**
2. Basir, M. A., *Can. J. Zool.*, 1948, **26**, 197.
3. Baylis, H. A., *The Fauna of British India Including Ceylon and Burma, Nematoda*, Taylor and Francis, London, 1939, **2**, 274.
4. Bhalerao, G. D., *Helminth Parasites of Domesticated Animal in India*, The Imperial Council of Agricultural Research, Scientific Monograph No. 6, 1935, p. 365.
5. Boughton, R. V., *Univ. of Minn. Agr. Exp. Sta. Tech. Bull.*, 1937, **121,** 1.
6. Cram, E. B., *Trans. 18th Amer. Game Conference*, 1932, p. 243.
7. Dixon, J. M. and Robertson, J. H., *Avian Dis.*, 1967, **11**, 41.
8. Garg, R. K., *Indian J. Helminth.*, 1970 (In press).
9. Gupta, V. P and Pande, B. P., *Agra Univ. J. Res.* (*Sci.*), 1963, **12**, 199.
10. Hobmaier, M., *J. Parasit.*, 1941, **27,** 233.
11. Karve, J. N., *Livro Jubilar Prof. Travassos,* Rio de Janeiro, 1938, p. 251.
12. Mirza, M. B., *Z. ParasitKde*, 1934, **6,** 638.
13. Petri, L. H., *Trans. Cans. Acad. Sci.*, 1950, **53,** 331.
14. — and Ameel, D. J., *J. Parasit.*, 1950, **36** (6 Sect. 2), Suppl. 40.
15. Schell, S. C., *Ibid.*, 1952, **38,** 462.
16. Soulsby, E. J. L., *Text-book of Veterinary Clinical Parasitology*, Blackwell Scientific Publications, Oxford, 1965, p. 1120.
17. Stewart, F. H., *Rec. Indian Mus.*, 1914, **10,** 245.
18. Thapar, G. S., *Indian J. vet. Sci.*, 1956, **26,** 211.
19. Yamaguti, S., *Systema Helminthum. The Nematodes of Vertebrates.* Vol. III. Parts I and II, Interscience Publishers, Inc., New York and London, 1961, p. 1261.
20. Zago Filho, H., *Revta bras. Biol.*, 1957, **17,** 513.
21. —, *Archos. Zool. Est.*, S. Paulo., 1958–62, 1962, **2,** 59.

USE OF MUSHROOM EXTRACT IN CULTURE OF *RHIZOBIUM*

VARIOUS laboratory media have been used to grow *Rhizobium,* the chief carbon source being sucrose or mannitol.[1,3,5] In this laboratory the sucrose or mannitol has been replaced by malt extract in the preparation of legume inoculants.[7] So far as the yeast-extract is concerned other extracts such as that of hardwood ash, root extract, sauerkraut juice, thiamine and biotin have been used in its place.[2,4,9-11]

An edible mushroom (*Psalliota compestris*) is being used as a nutritious food all over the world; however its utility as a component of synthetic medium has not been known so far. An attempt has been made in the present investigation to see if yeast-extract can be substituted by an extract of the *Psalliota.* The water extract of *Psalliota* used as 10 ml. of 10% W/v (obtained by steaming for ½ hour and filter) in 100 ml. of the usual mannitol medium (pH adjusted to 7·0) contained approximately 1·2% protein, 4% carbohydrate, 0·007% Ca, 0·1% Fe, 0·012% thiamine, 0·25% riboflavin and 0·2% niacin.[8] Five efficient strains of *Rhizobium* spp. were grown in the medium and were shaken in a rotary shaker for 72 hours for fast and 144 hours for slow growing rhizobia at 28–30° C. Standard yeast-extract mannitol medium was used as control for comparison.

Plate counts of each species were made by standard dilution procedure on the yeast-extract mannitol agar medium containing Congo red in the medium.[6] The results are presented in Table I.

TABLE I

No. of rhizobia/ml in yeast-extract-mannitol and mushroom-extract mannitol medium (*Av. of 4 reps.*)

Species		Yeast extract mannitol medium	Mushroom-extract mannitol medium
Rh. trifolii (Berseem)	11	90×10^{12}	60×10^{12}
Rh. meliloti (Lucerne)	—1A	70×10^{12}	80×10^{12}
Rh. leguminosarum (Pea)	12	40×10^{12}	11×10^{12}
Rhizobium sp. (Cowpea-gp.) (Groundnut)	GN2	76×10^{11}	42×10^{11}
Rh. japonicum (Soybean)	SB16	20×10^{9}	12×10^{9}

The results indicate that the growth in the two media are generally comparable depending upon the strains used and mushroom extract can be used as a growth factor for *Rhizobium*.

The authors are grateful to Dr. W. V. B. Sundara Rao, Head of the Division of Microbiology, for facilities and P. H. Graham, FAO Expert in Soil Microbiology in this Division, for going through the manuscript.

Division of Microbiology, V. ISWARAN
Indian Agri. Res. Institute, K. S. JAUHRI
New Delhi-12 (India), T. C. S. RAMU
March 11, 1970

---

1. Albrecht, M. F. and McCalla, T. M., *J. Bact.*, 1937, **34**, 455.
2. Allison, F. E. and Hoover, S. R., *J. Bacteriol.*, 1934, **27**, 561.
3. Bergersen, F. J., *Aust. J. Biol. Sci.*, 1961, **14**, 349.
4. Ferry, P., Blachere, H. and Obaton, M., *Ann. Agron. Paris*, 1959, **10**, 219.
5. Fred, E. B., Baldwin, I. L. and McCoy, E., *Root Nodule Bacteria and Leguminous Plants*, Univ. Wisconsin Press, Madison, 1932.
6. Hahn, N. J., *Can. J. Microb.*, 1966, **12**, 725.
7. Iswaran, V. and Jauhri, K. S., *Curr. Sci.*, 1969, **38**, 67.
8. Israel S. Kleiner, and James, M. Orten, *Biochemistry* 6th Ed., The C. V. Mosby Co., St. Louis, 1962, p. 307.
9. Norris, D. O., *Aust. J. Agric. Res.*, 1969, **10** (5), 651.
10. Rudakov, K. I., *Nitrogen Mikrobiologiya*, 1951, **20**, 348.
11. West, P. M. and Wilson, P. W., *Jour. Bact.*, 1939, **37**, 161.

PAPER CHROMATOGRAPHIC STUDIES OF ANTHOCYANINS IN SOME ARID ZONE PLANTS

FLORAL pigments and their separation and classification into florachromes as Florachrome A and Florachrome B have been demonstrated.[1,2] This concept has revolutionized the older and original concept of anthocyanin pigments, in floral pigmentations. Isolation of anthocyanin pigments is not only time-consuming but also expensive as regards material, solvent and other reagents.[5] Keeping this fact in view inflorescence (cyathia) from a number of individual plants of *Euphorbia caducifolia* (varying shades of red, buff and green), fruits of *Solanum nigrum* (orange and purplish-black), and petals of *Solanum surattense* were chromatographically studied for this report.

The samples throughout this study were treated by the one-way ascending procedure using Whatman No. 1 chromatography paper. The developing solvent employed was *n*-butanol : hydrochloric acid (conc.): water (7 : 2 : 5) for anthocyanins. For the extraction of the anthocyanins in the plants to be studied, a few fresh cyathia (*E. caducifolia*), fruits of orange and purple-black colours (*S. nigrum*) or purple petals (*S. surattense*) were immersed in 20 ml. or more cold methanol containing 1% hydrochloric acid overnight and filtered. The filtrates containing extracted pigments were used for paper chromatographic analysis. Authentic specimens of Cyanin (3, 5-diglucoside), Delphin (3, 5-diglucoside), Pelargonin (3, 5-diglucoside) and Tulipanin (3-rhamnosyl glucoside) were also cochromatographed.

Different anthocynins obtained chromatographically from the above-mentioned plant parts together with authentic ones, their Rf-values and colour shades are presented in Table I.

TABLE I

Rf-values and colour shades of isolated anthocyanins in n-butanol : hydrochloric acid : water (7 : 2 : 5)

Plant species/authentic specimen	Rf-values	Colour shades
E. caducifolia (green)	Nil	Nil
E. caducifolia (red, buff, etc.)	·83 ·89	Pink
S. nigrum (orange)	Nil	Nil
S. nigrum (purple-black)	·37–·41	Purple
S. surattense (purple)	·47–·56	Pinkish-purple
Cyanin	·62	Purple-red
Delphin	·80	Purple
Pelargonin	·48	Red-orange
Tulipanin	·72	Purple

Labidura reparia[2]; quail, *Colinus virginianus*[7]; and *Uromastix hardwickii.*[8]

Observations on larval development and life-cycles are available for *P. turgida* Rudolphi, 1819[1]; *P. maxillaris* Mòlin, 1860[10]; *P. rara*[13,14]; *P. prœputialis*[14,20,21]; and *P. hispida* Schell, 1950.[15] The intermediate or/and paratenic hosts for the encysted physalopterid larvæ, so far reported from Indian region, are: *B. stomaticus, S. palmarum, H. flaviviridis, L. reparia* and *U. hardwickii.*

Numerous specimens of the larvæ found encapsulated in the muscles and the mesentery of the spiny-tailed lizard were fed to laboratory-reared kittens (4), pups (18), chick (1) and laboratory-bred rabbits (3), white albino mice (2) and white albino rats (5) to determine their specific identity. Different stages of the developing juveniles were recovered, on autopses conducted at intervals, from the infected pups. The two cats, slaughtered on the 20th and 90th day of the infection, yielded fourth-stage juveniles and adults. 2 rabbits and 2 rats, however, yielded re-encysted larvæ from the gastric wall and the mesentery, the other infected animals were found to be negative.

From a detailed study of the live and the fixed specimens (cleared in 70% alcohol-glycerine or lactophenol), the material was determined as belonging to *P. brevispiculum.* The size-ranges were within those given for this species by Baylis (1939). The present findings on the mammalian phase of the life-cycle, *i.e.*, the development of infective larvæ, collected from a paratenic host, to maturity adds to the list of the life-cycles so far known for *P. turgida, P. maxillaris, P. rara, P. prœputialis,* and *P. hispida* in which, however, the intermediate hosts used for experimentation were arthropods. Detailed account of the stages in development is being published elsewhere.

Grateful acknowledgement is due to the Indian Council of Agricultural Research for the award of Senior Research Fellowship in Helminthology (to V. P. G.) and to the Principal of the College for facilities provided.

Dept. of Parasitology, V. P. Gupta.
U.P. College of Veterinary B. P. Pande.
Science and Animal Husbandry,
Mathura (U.P.), *February* 13, 1970.

---

1. Alicata, J. E., *Rabot, Gel'mint.* (Skrjabin), 1937, **11.**
2. Basir, M. A., *Can. J. Zool.*, 1948, **26**, 197.
3. Baylis, H. A., *The Fauna of British India Including Ceylon and Burma, Nematoda*, Taylor and Francis, London, **1939**, **2**, 274.
4. Bhalerao, G. D., *Helminth Parasites of Domesticated Animal in India*, The Imperial Council of Agricultural Research, Scientific Monograph No. 6, 1935, p. 365.
5. Boughton, R. V., *Univ. of Minn. Agr. Exp. Sta. Tech. Bull.*, 1937, **121**, **1.**
6. Cram, E. B., *Trans. 18th Amer. Game Conference*, 1932, p. 243.
7. Dixon, J. M. and Robertson, J. H., *Avian Dis.*, 1967, **11**, 41.
8. Garg, R. K., *Indian J. Helminth.*, 1970 (In press).
9. Gupta, V. P and Pande, B. P., *Agra Univ. J. Res.* (*Sci.*), 1963, **12**, 199.
10. Hobmaier, M., *J. Parasit.*, 1941, **27**, 233.
11. Karve, J. N., *Livro Jubilar Prof. Travassos*, Rio de Janeiro, 1938, p. 251.
12. Mirza, M. B., *Z. ParasitKde*, 1934, **6**, 638.
13. Petri, L. H., *Trans. Cans. Acad. Sci.*, 1950, **53**, 331.
14. — and Ameel, D. J., *J. Parasit.*, 1950, **36** (6 Sect. 2), Suppl. 40.
15. Schell, S. C., *Ibid.*, 1952, **38**, 462.
16. Soulsby, E. J. L., *Text-book of Veterinary Clinical Parasitology*, Blackwell Scientific Publications, Oxford, 1965, p. 1120.
17. Stewart, F. H., *Rec. Indian Mus.*, 1914, **10**, 245.
18. Thapar, G. S., *Indian J. vet. Sci.*, 1956, **26**, 211.
19. Yamaguti, S., *Systema Helminthum. The Nematodes of Vertebrates.* Vol. III. Parts I and II, Interscience Publishers, Inc., New York and London, 1961, p. 1261.
20. Zago Filho, H., *Revta bras. Biol.*, 1957, **17**, 513.
21. —, *Archos. Zool. Est.*, S. Paulo., 1958-62, 1962, **2**, 59.

USE OF MUSHROOM EXTRACT IN CULTURE OF *RHIZOBIUM*

Various laboratory media have been used to grow *Rhizobium*, the chief carbon source being sucrose or mannitol.[1,3,5] In this laboratory the sucrose or mannitol has been replaced by malt extract in the preparation of legume inoculants.[7] So far as the yeast-extract is concerned other extracts such as that of hardwood ash, root extract, sauerkraut juice, thiamine and biotin have been used in its place.[2,4,9-11]

An edible mushroom (*Psalliota compestris*) is being used as a nutritious food all over the world; however its utility as a component of synthetic medium has not been known so far. An attempt has been made in the present investigation to see if yeast-extract can be substituted by an extract of the *Psalliota.* The water extract of *Psalliota* used as 10 ml. of 10% W/v (obtained by steaming for ½ hour and filter) in 100 ml. of the usual mannitol medium (pH adjusted to 7·0) contained approximately 1·2% protein, 4% carbohydrate, 0·007% Ca, 0·1% Fe, 0·012% thiamine, 0·25% riboflavin and 0·2% niacin.[8] Five efficient strains of *Rhizobium* spp. were grown in the medium and were shaken in a rotary shaker for 72 hours for fast and 144 hours for slow growing rhizobia at 28–30° C. Standard yeast-extract-mannitol medium was used as control for comparison.

Plate counts of each species were made by standard dilution procedures on the yeast-extract-mannitol agar medium containing Congo red in the medium.[5,6] The results are presented in Table I.

TABLE I

No. of rhizobia/ml. in yeast-extract-mannitol and mushroom-extract-mannitol medium (Av. of 4 reps.)

Species		Yeast-extract-mannitol medium	Mushroom-extract-mannitol medium
Rh. trifolii (Berseem)	—Bf	90×10^{12}	60×10^{12}
Rh. meliloti (Lucerne)	—LA	70×10^{12}	80×10^{12}
Rh. leguminosarum (Pea)	—P2	40×10^{12}	11×10^{12}
Rhizobium sp. (Cowpea sp.) (Groundnut)	—GN2	76×10^{11}	42×10^{11}
Rh. japonicum (Soybean)	—SB16	20×10^{9}	12×10^{9}

The results indicate that the growth in the two media are generally comparable depending upon the strains used and mushroom extract can be used as a growth factor for *Rhizobium*.

The authors are grateful to Drs. W. V. B. Sundara Rao, Head of the Division of Microbiology, for facilities and P. H. Graham, FAO Expert in Soil Microbiology in this Division, for going through the manuscript.

Division of Microbiology, V. ISWARAN.
Indian Agri. Res. Institute, K. S. JAUHRI.
New Delhi-12 (India), T. C. S. RAMU.
March 11, 1970.

---

1. Albrecht, M. F. and McCalla, T. M., *J. Bact.*, 1937, **34**, 455.
2. Allison, F. E. and Hoover, S. R., *J. Bacteriol.*, 1934, **27**, 561.
3. Bergerson, F. J., *Amer. J. Biol. Sci.*, 1961, **14**, 349.
4. Ferry, P., Blachere, H. and Obaton, M., *Ann. Agron. Paris*, 1959, **10**, 219.
5. Fred, E. B., Baldwin, I. L. and McCoy, E., *Root Nodule Bacteria and Leguminous Plants*, Univ. Wisconsin Press, Madison. 1932.
6. Hahn, N. J., *Can. J. Microb.* 1966, **12**, 725.
7. Iswaran, V. and Jauhri, K. S., *Curr. Sci.*. 1969, **38**, 67.
8. Israel. S. Kleiner, and James, M. Orten, *Biochemistry* 6th Ed., The C. V. Mosby Co., St. Louis. 1962, p. 307.
9. Norris, D. O., *Aust. J. Agric. Res.* 1969, **10** (5), 651.
10. Rudakov. K. I., *Nitragin Mikrobiologiya*, 1951, **20**, 348.
11. West. P. M. and Wilson, P. W., *Jour. Bact.*, 1939, **37**, 161.

PAPER CHROMATOGRAPHIC STUDIES OF ANTHOCYANINS IN SOME ARID ZONE PLANTS

FLORAL pigments and their separation and classification into florachromes as Florachrome A and Florachrome B have been demonstrated.[1,2] This concept has revolutionized the older and original concept of anthocyanin pigments, in floral pigmentations. Isolation of anthocyanin pigments is not only time-consuming but also expensive as regards material, solvent and other reagents.[5] Keeping this fact in view inflorescence (cyathia) from a number of individual plants of *Euphorbia caducifolia* (varying shades of red, buff and green), fruits of *Solanum nigrum* (orange and purplish-black), and petals of *Solanum surattense* were chromatographically studied for this report.

The samples throughout this study were treated by the one-way ascending procedure using Whatman No. 1 chromatography paper. The developing solvent employed was *n*-butanol : hydrochloric acid (conc.): water (7 : 2 : 5) for anthocyanins. For the extraction of the anthocyanins in the plants to be studied, a few fresh cyathia (*E. caducifolia*), fruits of orange and purple-black colours (*S. nigrum*) or purple petals (*S. surattense*) were immersed in 20 ml. or more cold methanol containing 1% hydrochloric acid overnight and filtered. The filtrates containing extracted pigments were used for paper chromatographic analysis. Authentic specimens of Cyanin (3, 5-diglucoside), Delphin (3, 5-diglucoside), Pelargonin (3, 5-diglucoside) and Tulipanin (3-rhamnosyl glucoside) were also cochromatographed.

Different anthocynins obtained chromatographically from the above-mentioned plant parts together with authentic ones, their Rf-values and colour shades are presented in Table I.

TABLE I

Rf-values and colour shades of isolated anthocyanins in n-*butanol : hydrochloric acid : water (7 : 2 : 5)*

Plant species/authentic specimen	Rf-values	Colour shades
E. caducifolia (green)	Nil	Nil
E. caducifolia (red, buff, etc.)	·83–·89	Pink
S. nigrum (orange)	Nil	Nil
S. nigrum (purple-black)	·37–·41	Purple
S. surattense (purple)	·47–·56	Pinkish-purple
Cyanin	·62	Purple-red
Delphin	·80	Purple
Pelargonin	·48	Red-orange
Tulipanin	·72	Purple

Besides these above, anthocyanins were also extracted from the plant species (floral petals) as given in Table II. Their Rf-values for comparison with the arid zone species are also given.

It is evident from this preliminary identification of the anthocyanins that green forms of *E. caducifolia* contains no anthocyanin pigments at all.[3] A coloured inflorescence is most attractive for pollinating agents (insects). Since *E. caducifolia* is allogamous, green-coloured influorescence are in the process of disappearance.[3] In other forms, only one type of anthocyanin with pink colour was found. In orange-coloured fruits of *S. nigrum* also, no anthocyanin was found to be present.[4] In purple-black fruits, one anthocyanin (Rf-values ·37–·41) was discovered, which nearly matched with one of the anthocyanins in *Petunia violacea*. In the petals of *S. surattense* two anthocyanins appeared to be present. One (Rf-values ·47–·56) is very much prominent with pinkish-purple colour. This matched strikingly with one (Rf-value 45) in *Petunia violacea.*

TABLE II

Anthocyanins extracted from other flowers with their Rf-values and colour shades in n-*butanol : hydrochloric acid : water* (7 : 2 : 5)

Plant species		Rf-values	Colour shades
Petunia violacea	..	·45	Pinkish-purple
	..	·79	Purple
Antirrhinum majus	..	·47	Pinkish red
Clarkia elegans	..	·80	Purple
Hibiscus schizopatalus	..	·30	Red
Malva sylvestris	..	·74	Purple
Nasturtium officinalis	..	·40	Orange-red
	..	·48	Pinkish-red

None of the investigated anthocyanins matched with the available authentic specimens.

Authentic specimens of anthocyanins supplied by Dr. N. Ishikura of Japan is gratefully acknowledged.

Botany Department,
University of Jodhpur,
Jodhpur (Rajasthan), India,
March 11, 1970.

D. N. SEN.
K. D. SHARMA.
D. D. CHAWAN.

---

1. Raman, C. V., *Curr. Sci.*, 1969, **38**, 179.
2. —, *Ibid.*, 1969, **38**, 451.
3. Sen, D. N., *Folia Geobot. et Phytotax.*, 1968, **3**, 1.
4. Sharma, K. D. and Sen, D. N., *Curr. Sci.*, 1969, **38**, 394.
5. Shibata, M., Ishikura, N. and Hasegawa, K., *Kumamoto J. Sci.*, 1967, **8**, 35.

Note by Referee—The anthocyanins are not the floral pigments: vide *Current Science*, 1969, 38, 179 and 451.

REVIEWS AND NOTICES OF BOOKS

Annual Review of Medicine (Vol. 21). Edited by Arthur C. DeGraff. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1970. Pp. 501. Price: Postpaid U.S.A. $ 10.00; Foreign $ 10.50.

As in previous volumes, the Editorial Committee has selected topics for review in areas of medicine where significant advances have been made in the past few years, or where reappraisal with a fresh point of view is desired.

The contents of this volume under review are: Immunologic Aspects of Renal Disease; Current concepts of Interferon and Interferon Induction; Treatment of Ventricular Extrasystoles and Tachyarrhythmias in Acute Myocardial Infraction; Topical Antimetabolites; Chemical Causes of Pain and Itch; Renal Regulation of Sodium Excretion; Cystic Fibrosis in Adults; Leukocytic Mechanisms in Inflammation; Microangiopathic Hemolytic Anemia; Absorption of Iron; Diseases Due to Abnormalities of Hemoglobin Structure; *Mycoplasmas* As Infectious Agents; Human Reaginic Antibodies; Toxoplasmosis: Recent Developments; Human Insulin Secretion: An Integrated Approach; Some Endocrine and Metabolic Aspects of Obesity; Hypo-Osmolar Syndromes Secondary to Impaired Water Excretion; Edema; Structure and Function of Mucosal Antibodies; Regulation of the Secretions of the Pancreas; Cerebral Lipidoses; Dietary Treatment of Inborn Errors of Metabolism; Crystal-Induced Inflammation of the Joints; Chemotherapy of Mental Depression; Chromosomal Abnormalities in Human

Neoplasia; Human Chromosome Damage by Chemical Agents; and L-Asparaginase.

C. V. R.

Non-equilibrium Flows (Vol. 1). Part II. Edited by Peter P. Wegener. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xi + 236. Price $ 13.50/£ 6.9 *sh.* 0 *d.*

The aim of this series is to treat the fundamentals of gasdynamics as well as the advances of recent years. The topic of gasdynamics is interpreted to include any aspect of the dynamics of real gases, the underlying theme being the effects of compressibility. The articles in a single volume will cover only one major subject, the intention being to show some of the many sides of that subject to students and to those already working primarily in a narrower speciality.

A review of Vol. 1, Part I, of this series was published in the columns of the issue of *Current Science* dated December 20, 1969, 38 (24), page 599.

Part II under review contains a historical view of linear non-equilibrium problems discussed from the viewpoint of a physicist, an original contribution on weak non-linear waves, and extensive discussions including many practical applications on expansion flows and the method of characteristics. Future volumes will include experimental methods and discussions of facilities of particular interest to those aspects of ærodynamics that relate to flight at extreme speeds. Furthermore, diagnostic techniques and special instrumentation for compressible flows will be included. This book can be used as a text-book by graduate students in advanced fluid mechanics courses. It is also valuable to ærospace engineers, scientists in the chemical processing industry, and researchers in physics, chemical physics, and engineering.

C. V. R.

Organic Photochemistry (Vol. 2). Edited by Orville L. Chapman. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 230. Price $ 13.75 or £ 6.11 *sh.* 0 *d.*

Organic photochemistry is the science arising from application of photochemical methods to organic chemistry and organic chemical methods to photochemistry. It is an interdisciplinary frontier.

Intense activity in organic photochemistry in the last decade, especially in the last five years, has produced so vast an accumulation of factual knowledge that chemists in general have viewed it with awe. Even those chemists engaged in the study of organic photochemistry find the rate of development of the field perplexing in high degree. This series has been created to fill the need for a critical summary of this vigorously expanding field with the purpose of drawing together seemingly unrelated facts, summarizing progress, and clarifying problems.

The subject-matter in this volume under review has been dealt with under the following headings: Photosensitization by Energy Transfer, by Nicholas J. Turre, J. Christopher Dalton, and David S. Weiss; Photodimerizations, by David J. Trecker; The Photochemistry of Heteroaromatic Nitrogen Compounds, by Peter Beak and Wayne R. Messer; and Photochemical Additions to Multiple Bonds, by Dov Elad.

C. V. R.

Methods of Free-Radical Chemistry (Vol. 2). Edited by E. S. Huyser. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xi + 242. Price $ 12.75 or £ 6.2 *sh.* 0 *d.*

This series, *Methods in Free-Radical Chemistry* consists of critical reviews written by young researchers who have displayed a degree of expertise in a particular area of this field. The authors have not only published in their own area, but in most cases, have had direct experience with the work in the laboratory.

The chapters contained in Volume 2 of this series are: 1. Thiyl Radicals, by Richard M. Kellogg; and 2. Free-Radical Brominations, by Warren A. Thaler.

The first volume of the series contains chapters on the free-radical aspects of certain photochemical processes, on electron spin resonance as related to organic radicals, and on free-radical chlorination reactions. Topics from Volume 3 onwards will include free-radical reactions of metal ions, electrochemical processes, and certain types of redox reactions.

C. V. R.

Bibliography of Fossil Vertebrates (1959-1963). By C. L. Camp, H. J. Allison, R. H. Nichols and H. McGinnis, Museum of Palaeontology, University of California, Berkeley. (The Geological Society of America, Inc., Colorado Building, P.O. Box 1719, Boulder, Colorado 80302), 1968. Pp. xlii + 644. Price $ 14.50.

The Geological Society of America has been bringing out this series of bibliography of

Fossil Vertebrates treating the world literature of the subject from 1928 onwards. Previous volumes have appeared either as G.S.A. Special Papers (Nos. 27 and 42), or as G.S.A. Memoirs (37, 57, 84 and 92). Each volume covers a five-year period.

The present volume is the seventh in this series and appears as G.S.A. Memoir 117. It covers the period 1959–63. The bibliography is arranged under the following heads: Author Catalogue (pp. 1–382), Subject Index (383–490), Systematic Index (491–620) and Synopsis of Classification (621-644). A supplementary list of new serials with their call numbers for the University of California Library, is also included in the beginning (ix-xiii). A. S. G.

A Text-Book of Bacteriology. By A. K. Dutta. (Published by Bharati Bhawan, Exhibition Road, Patna-1), 1970. Pp. 184. Price Rs. 15.

This is a well-written book on bacteriology which is bound to be popular with the students of agricultural colleges. The treatment is lucid and systematic. The text deals with all aspects of bacteria, the unicellular organisms, their structure and morphology, their nutrition, reproduction and growth, and the effects which chemicals and environmental factors have on them. There are chapters devoted to fermentation, protein decomposition, food preservation, milk bacteriology and soil bacteriology. A special chapter deals with bacterial diseases of plants. The text is illustrated with fifty figures and two-coloured plates.

Besides its chief use as a text-book for agricultural college students, this, monograph should also appeal to the general reader who is naturally interested in bacteria and the vital role they play in our lives. A. S. G.

Treatise on Invertebrate Paleontology. (Part R) Arthopoda 4 (in two volumes). Editor: Raymon C. Moore. (The Geological Society of America, P.O. Box 1719, Boulder, Colorado 80302), Vol. 1: Pp. xxxv + 398; Vol. 2: Pp. 399–651 with 1,762 figs. Price $ 10.00.

This *Treatise on Invertebrate Paleontology* being brought out in several parts is well known to palaeontologists. Already 16 parts have been published and a dozen more including revisions are in preparation.

The work is aimed at providing a most useful summary of the collective results of almost all significant investigations done upto the middle of the present century on invertebrate fossil groups. It is an indispensable reference work for all research workers and students who are concerned with the study of the remains of invertebrate organisms preserved in rocks of the earth's crust.

The present unit of the Treatise is Part R and the fourth one on Arthropoda. It is concerned with Crustacea exclusive of Ostracoda, Myriapoda and Hexapoda. The three beginning chapters include two by Sidnie M. Manton, the first on Classification of Arthropoda, and the second on Evolution and Affinities of Onychophora, Myriapoda, Hexapoda, and Crustacea. R. C. Moore and Lavon McCormick have contributed the third chapter on General Features of Crustacea.

Part R is being issued in three volumes, the present two and a third one to come on fossil insects with text and illustrations. A. S. G.

Books Received

The Indian Ephemeris and Nautical Almanac for the Year 1971. (The Manager, Publications, Civil Lines, Delhi), 1970. Pp. xxii + 467. Price Rs. 17 or 39 *sh.* 8 *d.* or $ 6.12.

Clean Surfaces—The Preparation and Characterization for Interfacial Studies. By G. Goldfinger. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1970. Pp. xix + 385. Price $ 18.75.

Spectral Analysis, Methods and Techniques. Edited by J. A. Blackburn. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1970. Pp. xi + 289. Price $ 15.75.

Modern Physical Theory (Special Relativity and Quantum Physics). By T. D. Sanders. (Addison-Wesley Pub. Co., London W. 1, England), 1970. xii + 588. Price not given.

Fundamental Concepts of Modern Mathematics. By Larson. (Addison-Wesley Pub. Co., London W. 1, England), 1970. Pp. 146. Price 46 *sh.*

Introduction to Laboratory Chemistry—Organic and Biochemistry. By A. L. Williams, R. W. Richardson, H. J. Debey, L. A. Kelly and O. G. Lien. (Addison-Wesley Pub. Co., London W. 1, England), 1970. Pp. viii + 180. Price not gvien.

Finite Probability. By M. Gemignani. (Addison-Wesley Pub. Co., London W. 1, England), 1970. Pp. 122. Price not given.

2201-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

RAMAN AND INFRARED SPECTRA OF PHENANTHRENEQUINONE

G. D. BARUAH, D. N. TRIPATHI AND S. NATH
Spectroscopy Department, Banaras Hindu University, Varanasi-5 (U.P.)

ABSTRACT

The Raman and infrared spectra of phenanthrenequinone have been studied in the region 250–4000 cm.$^{-1}$ Vibrational assignments of all the prominent bands have been made by taking aid from the crystal spectrum of phenanthrene. A close correspondence has been observed between the fundamental vibrational frequencies of the molecules phenanthrene and phenanthrenequinone.

INTRODUCTION

THE vibrational spectra of several polycyclic aromatic hydrocarbons, *e.g.*, naphthalene,[1] anthracene,[2-8] pyrine,[9] perylene,[10] phenanthrene,[11] naphthoquinone,[12] anthraquinone[12] and several condensed ring aldehydes[13] have been studied in detail at various laboratories. The spectra of these molecules are usually complex and the assignments are essentially based on the analysis of the crystal spectra. The interpretation of crystal spectra helps to a great extent the identification of the symmetry species of the observed bands. The present paper describes the result obtained for phenanthrenequinone including the analysis of the infrared spectra taken in nujol and KBr and Raman spectrum recorded with the help of Laser source. The crystal spectrum of phenanthrenequinone is not available at present. Thus the assignment has been made wth the help of the crystal spectrum of phenanthrene[11] because of the structural similarity of the two molecules.

EXPERIMENTAL

The infrared spectrum of the molecule was measured between 4000–250 cm.$^{-1}$ with the aid of a Perkin-Elmer Grating Spectrophotometer (Model 521). The thin film spectra were recorded by making paste of compounds with nujol and pressed between two CsBr windows and also in KBr. Phenanthrenequinone used was reagent grade purified by sublimation. The laser traced Raman spectrum was obtained through the courtesy of Prof. J. R. Durig of South Carolina University.

RESULTS AND DISCUSSIONS

The molecule belongs to the point group C_{2v}. The 66 normal modes of vibration would be divided among the symmetry species $23\ A_1 + 11\ A_2 + 10\ B_1 + 22\ B_2$.

The molecule is assumed to be planar. The Z-axis is chosen as the highest symmetry axis (*i.e.*, C_2-axis) passing through the middle point of the CC bond between two C=O bonds. Out of 66 normal modes of vibrations, 55 are infrared-active while 11 vibrations belonging to A_2 are inactive in infrared. All vibrations are Raman-active. The assignments of the bands have been made by taking aid from the vibrational assignment of the crystal spectrum of phenanthrene[11] and from the similar molecules. Table I collects the available data for phenanthrenequinone including the Raman spectrum and infrared spectra taken in nujol and KBr.

A_1 fundamentals.—It has been observed that the frequencies 750, 1035, 1160, 1230, 1420, 1504, 3015 and 3050 cm.$^{-1}$ appear with considerable intensity. These can be correlated with the frequencies 710, 1038, 1142, 1200, 1441, 1524, 3020 and 3050 cm.$^{-1}$ in the Raman spectrum of phenanthrene crystal identified as A_1 fundamentals. The ring-breathing frequency in the infrared spectrum has been observed at 760 cm.$^{-1}$ and in the Raman spectrum, this has been identified with frequency 750 cm.$^{-1}$ In the crystal spectrum of phenanthrene the ring-breathing mode of vibration has been identified with a strong band at 710 cm.$^{-1}$ A very strong band at 1679 cm.$^{-1}$ in the Raman spectrum and at 1675 cm.$^{-1}$ in the infrared spectrum of the molecule has been undoubtedly assigned to C=O stretching mode of vibration as this band appears very prominently in all other quinones[12] and have been assigned as A_1 fundamentals.

A_2 fundamentals.—The 11 fundamentals of A_2 species are infrared-inactive for a free molecule but may appear in the crystal spectrum. The Raman frequencies 360 and 468 cm.$^{-1}$ in phenanthrenequinone do not have any counterparts in the infrared spectrum. Thus these two can be conveniently chosen as fundamentals of A_2 type.

B_2 fundamentals.—A very strong band at 614 cm.$^{-1}$ in the Raman spectrum and at 620 cm.$^{-1}$ in the infrared spectrum has been assigned as the out-of-plane skeletal deformation of B_2

TABLE I

Vibrational assignments of phenanthrenequinone

Raman	I.R. nujol	I.R. KBr	Assignment
	310 (3)	308 (1)	B_1 Skeletal deformation o.p.
352 (w)			A_2 Skeletal deformation o.p.
	360 (3)	356 (2)	B_1 Skeletal deformation o.p.
	370 (2)	368 (2)	B_1 Skeletal deformation o.p.
	380 (3)	380 (1)	A_1 C=O bending i.p.
	395 (2)	385 (2)	B_1 Skeletal deformation o.p.
	430 (3)	422 (6)	B_1 Skeletal deformation o.p.
468 (w)			A_2 Skeletal deformation o.p.
	526 (6)	510 (7)	B_1 Skeletal deformation o.p.
614 (s)	620 (4)	618 (3)	B_1 Skeletal deformation o.p.
	735 (5)	730 (2)	B_1 Skeletal deformation o.p.
750 (ms)	760 (7)	758 (6)	A_1 Ring breathing
	790 (1)	782 (5)	B_1 C—H bending o.p.
	840 (1)	835 (1)	A_1 Skeletal deformation i.p.
	870 (2)	879 (3)	B_1 C—H bending o.p.
	923 (2)	929 (3)	B_1 C—H bending o.p.
	960 (3)	965 (4)	B_1 C—H bending o.p.
1016 (s)	1010 (2)	1012 (2)	B_2 C—H bending i.p.
1035 (w)	1035 (2)	1030 (4)	A_1 C—H bending i.p.
	1120 (3)		B_2 C—H bending i p.
1160 (s)	1160 (3)	1165 (2)	A_1 C—H bending i.p.
1230 (w)	1229 (4)	1225 (3)	B_2 C—C stretching
1286 (vs)	1285 (10)	1284 (7)	A_1 C—C stretching
	1299 (6)	1292 (4)	A_1 C—C stretching
	1335 (3)	1330 (3)	B_2 C—C stretching
1355 (w)	1360 (6)	1365 (5)	A_1 C—C stretching
1420 (s)	1425 (6)	1420 (2)	A_1 C—C stretching
1504 (w)			B_2 C--C stretching
	1560 (3)	1571 (4)	B_2 C—C stretching
1593 (s)	1592 (7)	1600 (8)	A_1 C—C stretching
	1655 (2)	1660 (2)	B_2 C—C stretching
1679 (vs)	1675 (10)	1680 (9)	A_1 C=O stretching
	2720 (2)	2725 (1)	A_1 2724=1425 (A_1) +1299 (A_1)
	2981 (2)	2980 (2)	B_2 2985=1560 (B_2) +1425 (A_1)
3015 (vw)	3020 (1)	3010 (2)	B_2 C—H stretching
3050 (vw)	3050 (1)	3050 (1)	A_1 C—H stretching
	3115 (2)	3109 (1)	B_2 C—H stretching
	3150 (3)		A_1 3152=1592 (A_1) +1560 (A_1)
	3188 (3)	3170 (5)	A_1 C—H stretching
	3350 (2)	3359 (2)	A_1 3350=2×1675 (A_1)

Intensities are given in the parenthesis.

s=strong; w=weak; vs=very strong; vw=very weak; sh=shoulder.

type and are correlated with the frequencies 618 and 614 cm.$^{-1}$ observed in the infrared and Raman spectra respectively of phenanthrene. Ten fundamentals are identified at 614, 1016, 1035, 1160, 1420, 1505, 1593, 3015 and 3050 cm.$^{-1}$ These can be very easily correlated with the frequencies 618, 1002, 1039, 1148, 1500, 1548, 3024 and 3064 cm.$^{-1}$ identified as B_2 fundamentals in the Raman spectrum of phenanthrene.

B_1 fundamentals.—The B_2 fundamentals are non-planar and they are readily identified by making comparison with the spectrum of phenanthrene. These fundamentals have weak Raman activity and they are generally assigned from their characteristic a-polarisation. The bands occurring at 960, 870, 840, 735 and 430 cm.$^{-1}$ are B_1 fundamentals and can be identified with the frequencies 951, 874, 819, 735 and 431 cm.$^{-1}$ of phenanthrene.

Owing to the close similarity of the molecules, phenanthrene and phenanthrenequinone, some conclusions can be drawn from a comparison of their fundamental vibrations. It has been found that except for the carbonyl group vibrations there is a close correspondence between the fundamentals of the two molecules. Thus, the assignment in the present case as given in Table I is essentially correct.

ACKNOWLEDGEMENT

We wish to express our thanks to Prof. J. R. Durig for making available to us the Raman spectrum of the compound. One of us (G. D. B.) is thankful to the C.S.I.R. for the award of a Fellowship.

1. Sheerer, J., *J. Chem. Phys.*. 1962 **36,** 3308
2. Bruhn, W. and Mecke, R., *Z. Electrochem.*, 1961, **65,** 543.
3. Califano, S., *J. Chem. Phys.*, 1962, **36,** 903.
4. Colombo, L. and Mathieu, J., *Bull. Soc. Franc. Mineral Cryst.*, 1961, **83,** 250.
5. Califano, S., *Ric. Sci.*, 1963, **3,** 461.
6. Colombo, L., *Spectrochim. Acta*, 1964, **20,** 547.
7. Abasbegovic, N., Vukotic, N. and Colombo, L., *J. Chem. Phys.*, 1964, **41,** 2575.
8. Evans, D. J. and Scully, D. B., *Spectrochim. Acta*, 1964, **20,** 891.
9. Abbondanza, G. and Califano, S., *J. Chem. Phys.*, 1963, **39,** 1016.
10. Ambrosino, F. and Califano, S., *Spectrochim. Acta*, 1965, **21,** 1401.
11. Schettino, V., Neto, N. and Califano, S., *J. Chem. Phys.*, 1966, **44,** 2724.
12. Singh, S. N. and Singh, R. S., *Spectrochim. Acta*, 1968, **24 A,** 1591.
13. Singh, K., Singh, S. Nath and Rai, D. K., *Indian J. Pure & Appl. Phys.*, 1969, **7,** 638.

A NEW APPROACH TO ELOVICH EQUATION

R. P. VISWANATH, B. VISWANATHAN, V. SRINIVASAN AND M. V. C. SASTRI

Department of Chemistry, Indian Institute of Technology, Madras-36

THE chemisorption kinetic data are often analysed through a logarithmic relationship associated with Elovich.[1] Attempts[2-4] have been constantly made to rationalise this empirical equation by the use of suitable models based on the presence of site distribution on the surface of the solid. The integrated expression of the Elovich equation has the form :

$$q = \frac{1}{\alpha} \ln (t + t_0) - \frac{1}{\alpha} \ln t_0$$

where q is the amount of gas adsorbed (in cc NTP) at any time t and α and t_0 are constants. Since t_0 is usually small, it is often neglected and the experimental kinetic data are often examined through a plot of q as a function of log t, the slope of which yields the value of α and the intercept could be used to evaluate another constant of the Elovich equation, namely, 'a', through the relationship $t_0 = 1/a\alpha$. The dependence of these constants on temperature and pressure, though studied widely,[5] has not resulted in understanding the functional relationship of these parameters. In the present study, an attempt has been made to elucidate the physical significance of the parameters and to evolve methods for evaluating them from primary kinetic data on the chemisorption of hydrogen on iron oxide.

Iron oxide was prepared by the decomposition of AnalaR grade ferric nitrate in air at 400 ± 10° C. for 9 hours. The results reported here pertain to adsorption by 3·13 gm. of the oxide (Fe_2O_3) whose surface area was found to be 14·0 m^2 by the BET method. The measurements of adsorption were carried out in a volumetric apparatus similar to the one reported by Srinivasan.[6] Each adsorption experiment was preceded by evacuation for an hour at the temperature of the experiment, to avoid reduction by previously adsorbed hydrogen, followed by evacuation at 400° C. for 8 hours at 10^{-6} mm. Hg.

The evaluation of t_0.—Attempts to calculate q making use of the integrated equation have not resulted in getting values that were obtained experimentally, obviously on account of the omission of the constant t_0 in the plots of Elovich equation. In the present study a successive approximation procedure has been utilised to obtain the values of the integration constant t_0. This was done by successively regressing the value of t_0, obtained approximately from the intercept of the plot of q versus log t of the Elovich equation, till a self-consistent value for t_0 was reached.

The evaluation of 'a'.—A plot of the amount adsorbed as a function of time, with the condition that $q = 0$ at $t = t_0$, is made, and from the initial slope of this plot the value of 'a', the initial rate, can be obtained.

The values of the parameters obtained by the treatment of experimental data on the adsorption of hydrogen on iron oxide in the temperature range 299-433° K., by the above procedure are summarised in Table I. Recently, Mclintock[7] has considered the parameters of

TABLE I

Parameters of the Elovich equation for the adsorption of hydrogen on iron oxide

At. Pr. = 76·0 cm.

Temp. °C.	Eq. Pr. cm. Hg.	t_0^1 min.	t_0^2 min.	α_1	α_2	t_b^1 min.	t_b^2 min.	q_b^1 CCNTP	q_b^2 CCNTP
26·5	At. pr.	0·432	4·21	6·22	2·19	14·55	..	0·56	..
56	49·51	0·724	1·73	3·80	2·30	6·45	42·56	0·58	1·41
56	At. pr.	0·419	0·17	3·67	1·91	3·62	26·30	0·58	1·62
80	49·60	0·582	..	2·66	..	33·19	..	1·53	..
80	At. pr.	0·284	..	2·39	..	46·88	..	2·14	..
100	29·87	0·275	..	4·84	..	7·24	..	1·18	..
100	49·59	0·302	..	2·82	..	9·31	..	1·22	..
100	At. pr.	0·374	..	2·01	..	9·91	..	1·63	..
142	29·30	0·0058	..	9·73	..	..	..	..	..
142	49·27	0·072	..	3·35	..	2·82	..	1·10	..
142	At. pr.	0·042	..	2·88	..	2·32	..	1·39	..
160	29·71	0·001	..	12·36	..	..	..	..	..
160	49·23	0·0086	0·019	3·42	3·07	12·85	..	2·14	..
160	At. pr.	0·0074	0·053	2·12	1·59	17·99	..	3·67	..

the Elovich equation and has concluded that t_0 has only a mathematical role in the equation and that no physical significance could be attributed to it. However, in the present instance, the plot of the amount adsorbed against logarithm of $(t + t_0)$ (in seconds) was seen to intersect the x-axis at time t_0, as shown in Fig. 1 indicating that the process of adsorption is initiated only after a time-lag of t_0. This induction period could be associated with the activation of the gas molecules for adsorption. Such a physical significance for t_0 has been taken into consideration in the evaluation of the values of the initial rates 'a', and the values thus obtained have been used in finding out the activation energy for the adsorption of hydrogen of iron oxide at atmospheric pressure using Arrhenius relationship. The value was found to be 2·6 K.cal./mole in the temperature range 299-433° K. It was found that the values of 'a' obtained by omitting t_0 in the Elovich equation did not vary consistently with temperature whereas the initial rate evaluated by the present procedure shows a consistent variation with temperature thus enabling one to get a meaningful value for the activation energy.

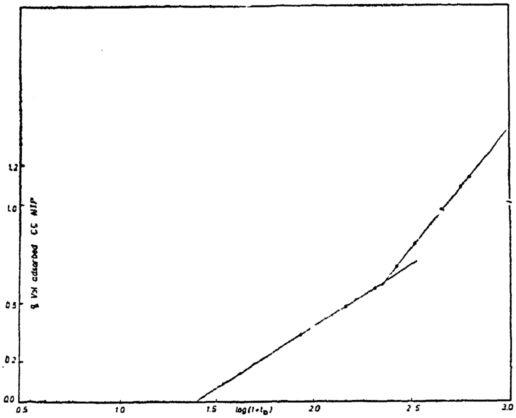


FIG. 1. Elovich plot for hydrogen adsorption on iron oxide at 56° C. and atmospheric pressure (× axis $t + t_0$ in seconds).

---

1. Taylor, H. A. and Thon, N., *J. Am. Chem. Soc.*, 1952, **74**, 4169.
2. Porter. A. S. and Tompkins, F. C., *Proc. Roy. Soc.*, 1953, **217 A**, 529.
3. Winter, E. R. S., *J. Catalysis*, 1965, **4**, 134.
4. Chandrasekaran, N., Viswanathan, B., Srinivasan, V. and Sastri, M. V. C., *Aust. J. Chem.*, 1968, **21**, 2575,
5. Low, M. J. D., *Chem. Revs.*, 1960, **60**, 267.
6. Srinivasan, V., *Proc. Ind. Acad. Sci.*, 1957, **46**, 120.
7. Mclintock, I. S., *J. Catalysis*, 1970, **16**, 126.

ISOLATION OF TRISOMICS AND TETRASOMICS IN GUAVA (*PSIDIUM GUAJAVA* L.)

P. K. MAJUMDER AND S. K. MUKHERJEE*

Division of Horticulture, Indian Agricultural Research Institute, New Delhi-12, India

THE study of aneuploidy has been widely appreciated for its great value in fundamental genetics, especially the monosomics, nullisomics and trisomics. The pioneer investigation on *Datura* by Blakeslee and Belling,[1] has stimulated many studies on annual crop plants, but no systematic approach has yet been made in tree fruits, particularly in guava. The present investigation was, therefore, undertaken to isolate trisomics and tetrasomics, which may be useful in studying cytogenetics of guava and in evolving guava with reduced seed number due to chromosome imbalance.

The plant materials were raised from seeds of open-pollinated triploid and crosses between the triploid ($3n = 33$) and diploid. The seeds were grouped into very big, big, medium and small classes on weight basis, and the seedlings were planted in 1963, whose chromosome numbers were determined from shoot and root tip squashes.

"Very big" seeds yielded 78% hypo- and hyper-triploid; "big seeds" gave 50% aneuploids with somatic chromosome numbers between 27 and 32, and only 17% from "medium-sized" seeds. "Small seed," on the other hand, yielded 88% aneuploids, which were mostly trisomics and tetrasomics.

Eight morphologically distinct trisomics were identified from the polygraphs (Fig. 1) adopting Hutchinson's technique in *Xanthium*.[2] Twelve distinctive vegetative characters were chosen for plotting polygraph which gave a simultaneous expression of different variable characters, which were further confirmed from the karyological analysis of different trisomics, where extra chromosome was morphologically distinct. The trisomics were mostly reduced in vigour in comparison to diploid sibs, with pollen sterility of 5 to 24%. At Metaphase I of meiosis, $11_{II} + 1_{I}$ association was more frequently observed (52-95%) than $10_{II} + 1_{III}$. The 11-12 distribution in Anaphase I was observed in 72 to 98% of PMCs (Fig. 2).

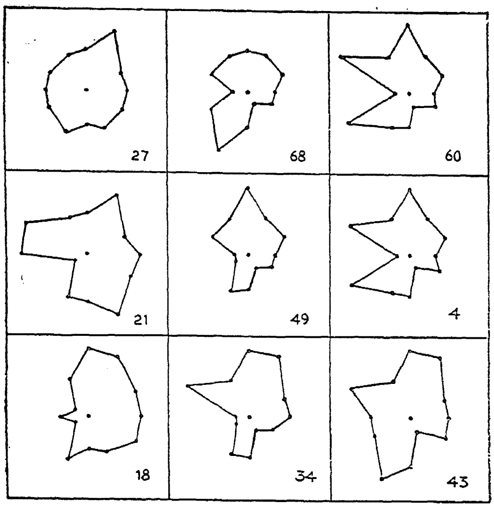


FIG. 1. Polygraphs of trisomics ($2n + 1$).

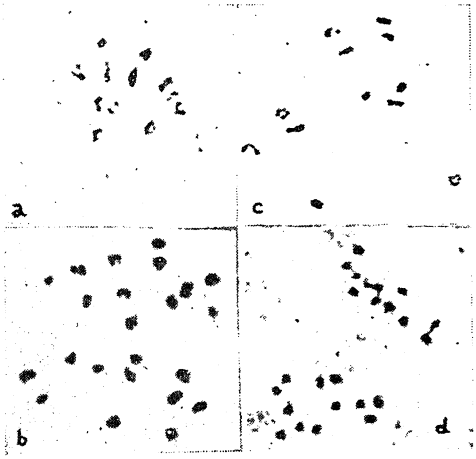


FIG. 2. (*a*) $2n + 1$ Metaphase $11_{II} + 1$, × 2,572. (*b*) $2n + 1$ Anaphase 11-12 distribution, × 2,695. (*c*) $2n + 2$ Metaphase 12_{II}, × 2,572. (*d*) $2n + 2$ Anaphase 12-12 distribution, × 2,572.

Out of 20 plants in 24-chromosome group, 17 were morphologically distinct. On the basis of chromosome association at Metaphase I and phenotypic appearance, 10 tetrasomics and 5 double trisomics were identified. The meiosis of remaining 5 plants could not be studied as they did not flower. The tetrasomics were usually shorter than the trisomics. Leaf size was most affected in the tetrasomics, with varying Metaphase I chromosomes association

---

[*] At present, Director, Botanical Survey of India, 14, Madan Street, Calcutta-13.

(Fig. 2). The pollen sterility was higher in tetrasomics than trisomics. Two tetrasomic types had fruits with normal size and shape, with much reduced seed size (75%) and the seed number of each fruit was half of the diploid cultivar.

Fruit shape was mostly deformed in hypertriploid, hypo-triploid and triploid types, probably because of high ovule sterility. It was found that tolerable limit of extra chromosome in case of guava was four, beyond this limit seed fertility and fruit shape was found to be adversely affected.

As guava is vegetatively propagated, the aneuploid types can very well be maintained unlike annual crop plants. The addition of two chromosomes to diploid number has shown great promise in guava improvement. This method of breeding can very well be adopted in tree fruits where numerous seeds decrease the fruit value.

---

1. Blakeslee, A. F. and Belling, J., *Amer. Nat.*, 1924, **56**, **16**.

2. Love, D. and Nadeau, L., *Canad. J. Genet. Cytol.*, 1961, **3**, 289.

A NOTE ON THE CYTOGENETIC STATUS OF *NICOTIANA AMPLEXICAULIS* BURBIDGE

D. M. GOPINATH, K. V. KRISHNAMURTHY AND A. S. KRISHNAMURTHY
Central Tobacco Research Institute, Rajahmundry, A.P.

WHILE assigning taxonomical positions for the five new Australian species of *Nicotiana*, Burbidge (1960) fixed *N. amplexicaulis* ($2n = 36$) between *N. gossei* ($2n = 36$) and *N. maritima* ($2n = 32$). Morphologically, *N. amplexicaulis* may well be regarded as a mini copy of *N. gossei* but bears little resemblance to *N. maritima*. Distributionally, the three species are widely separated, *N. gossei* in Central Australia, *N. amplexicaulis* in Queensland and *N. maritima* in South Australia. According to Goodspeed (1954) almost all the Australian species had their origin through amphidiploidy followed by chromosomal and genetic reorganisation. Aneuploidy through loss of chromosomes played an important part in the evolution of the Australian species in particular. In this context, the cytogenetic position of *N. amplexicaulis* was investigated to determine its relationship to the older species. For this purpose, inter- and intrasectional crosses between *N. amplexicaulis* and certain species of *Nicotiana* were done and the cytology of the hybrids followed. Since *N. amplexicaulis* is similar to *N. gossei* in chromosome number and also in morphology, comparison of chromosome behaviour of crosses between *N. gossei* and the same species involved in *N. amplexicaulis* crosses was made. The trend of cytogenetic behaviour of *N. gossei* and *N. amplexicaulis* is almost similar.

The chromosome pairing of *N. gossei* and *N. amplexicaulis* is given in Table I. From Table I it may be seen that a high degree of pairing between *N. amplexicaulis* as well as *N. gossei* with the species is evident. This points to a close genotypic homology between *N. gossei* and *N. amplexicaulis*. This is further proved by the complete pairing and fertility of the hybrids between the two species. The pairing relationship between *N. amplexicaulis* and the other species, as listed in Fig.

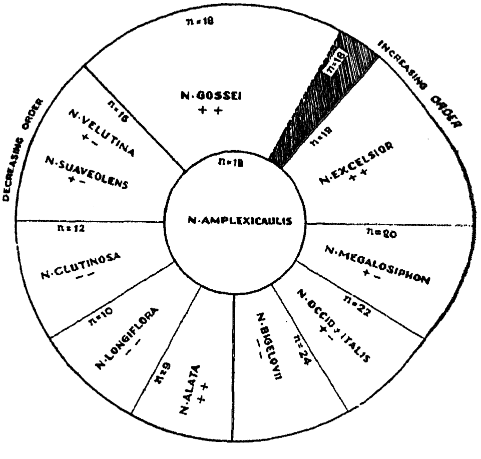


FIG. 1. Chart indicating *N. amplexicaulis* crosses with other species of *Nicotiana*. + indicates goodness and − indicates failure. First symbol for chromosome pairing and second symbol for pollen and seed fertility. The striped portion will be the cytogenetic location of *N. amplexicaulis*.

reveals another interesting feature. With certain species, the chromosome pairing was excellent but genetic abortion resulted in complete sterility both on the male and female sides. This is indicated in Fig. 1. The symbol + or − below the specific name indicates the chromosome pairing or its failure. The first symbol indicates pairing while the second symbol, goodness or failure of pollen and seed fertility as a consequence thereof. It may be seen from Fig. 1 that besides *N. gossei*, both pairing and fertility was obtained only in crosses with *N. excelsior* and *N. alata*. In the case of *N. excelsior*, no morphological similarity can be seen with *N. amplexicaulis*. Consequently, the derivatives from this cross looked quite different from either of the parents. Based on the inclusion or elimination of the extra *excelsior* chromosome, F_2 and F_3 generation also threw out different type of segregants.

With regard to the cross between *N. amplexicaulis* and other members of the Suaveolentes section, namely, *N. megalosiphon*, *N. occidentalis*, *N. velutina* and *N. suaveolens*, though chromosome pairing was excellent, fertility of the hybrids had been completely impaired. Considering all these facts of cytogenetic interest, it may not be improbable to fix *N. amplexicaulis* cytogenetically between *N. gossei* and *N. excelsior* as represented in Fig. 1. With regard to the complete pairing and fertility of the hybrid between *N. amplexicaulis* and *N. alata*, it is quite intriguing that a distant inter-sectional species, like *N. alata*, should have a very close affinity with *N. amplexicaulis*. Morphologically, these two species are poles apart. However, *N. gossei* and *N. alata* do not show such affinity (*vide* Table I). So it can be inferred that in the origin of *N. amplexicaulis* genotype, a greater expression of chromosomal homology derived from *N. alata* is amply evident. In this respect only, *N. amplexicaulis* differs from *N. gossei*. With species of other section, the hybrids were always sterile (Table I).

TABLE I

Chromosome pairing in interspecific hybrids involving either N. gossei *or* N. amplexicaulis *as one of the parents*

Cross*		Range of bivalent formation during meiosis in the hybrids	
		N. gossei†	*N. amplexicaulis*‡
1. *N. velutina* ($n=16$)	..	15 to 16	15 to 16
2. *N. suaveolens* ($n=16$)	..	13 to 15	15 to 16
3. *N. excelsior* ($n=19$)	..	17 to 18	17 to 18
4. *N. megalosiphon* ($n=20$)		13 to 17	17 to 18
5. *N. occidentalis* ($n=21$)		13 to 15	17 to 18
Inter-sectional hybrids:			
6. *N. glutinosa* ($n=12$)	..	..	3 to 7
7. *N. alata* ($n=9$)	..	0 to 3	12 to 13
8. *N. longiflora* ($n=10$)	..	0 to 3	0 to 3
9. *N. bigelovii* ($n=24$)	..	..	4 to 10

* The direction of cross not indicated.
† Reference : Goodspeed (1954).
‡ Reference : Gopinath *et al.* (1965).

As for the origin of *N. amplexicaulis*, it is found very difficult to determine through chromosome homology since the chromosomes of *N. amplexicaulis* freely paired with most of its sectional species. So test crosses did not give any clear indication. Overlapping as they do in geographical distribution, *N. gossei* and *N. excelsior* might have also hybridised and given rise to *N. amplexicaulis* type of plants. But the contrasting leaf and flower characters of the above species would scarcely support such an assumption. Further, flowers of *N. amplexicaulis* have little similarity with those of *gossei* or *excelsior*. Taxonomically *N. excelsior* is far below *N. amplexicaulis* in classification. The discovery of *N. amplexicaulis* as late as 1960 might indicate that it would have arisen as a hybridised product of the modern Australian species.

1. Burbidge, Nancy T., *Aust. J. Botany*, 1960 **8**, **342.**
2. Goodspeed, T. H., *Chronica Botanica*, Mass., 1954.
3. Gopinath, D. M., Krishnamurthy, K. V. and Krishnamurthy, A. S., *Can. J. Genet. Cytol.*, 1965, **7**, 328.

(Fig. 2). The pollen sterility was higher in tetrasomics than trisomics. Two tetrasomic types had fruits with normal size and shape, with much reduced seed size (75%) and the seed number of each fruit was half of the diploid cultivar.

Fruit shape was mostly deformed in hyper-triploid, hypo-triploid and triploid types, probably because of high ovule sterility. It was found that tolerable limit of extra chromosome in case of guava was four, beyond this limit seed fertility and fruit shape was found to be adversely affected.

As guava is vegetatively [illegible] the aneuploid types can [illegible] unlike annual crops [illegible] of two chromosomes [illegible] great promise [illegible]. The method of breeding [illegible] in tree fruits [illegible] the fruit value.

1. Blakeslee, A. F. and [illegible], 1924, 56, 16.

2. Love, D. and Nadeau, L., [illegible], 1961, 3, 289.

A NOTE ON THE CYTOGENETIC STATUS OF *NICOTIANA AMPLEXICAULIS* BURBIDGE

D. M. GOPINATH, K. V. KRISHNAMURTHY AND A. [illegible] KRISHNAMURTHY
Central Tobacco Research Institute, Rajahmundry, A.P.

WHILE assigning taxonomical positions for the five new Australian species of *Nicotiana*, Burbidge (1960) fixed *N. amplexicaulis* ($2n = 36$) between *N. gossei* ($2n = 36$) and *N. maritima* ($2n = 32$). Morphologically, *N. amplexicaulis* may well be regarded as a mini copy of *N. gossei* but bears little resemblance to *N. maritima*. Distributionally, the three species are widely separated, *N. gossei* in Central Australia, *N. amplexicaulis* in Queensland and *N. maritima* in South Australia. According to Goodspeed (1954) almost all the Australian species had their origin through amphidiploidy followed by chromosomal and genetic reorganisation. Aneuploidy through loss of chromosomes played an important part in the evolution of the Australian species in particular. In this context, the cytogenetic position of *N. amplexicaulis* was investigated to determine its relationship to the older species. For this purpose, inter- and intrasectional crosses between *N. amplexicaulis* and certain species of *Nicotiana* were done and the cytology of the hybrids followed. Since *N. amplexicaulis* is similar to *N. gossei* in chromosome number and also in morphology, comparison of chromosome behaviour of crosses between *N. gossei* and the same species involved in *N. amplexicaulis* crosses was made. The trend of cytogenetic behaviour of *N. gossei* and *N. amplexicaulis* is almost similar.

The chromosome pairing of *N. gossei* and *N. amplexicaulis* is given in Table I. From Table I it may be seen that a high degree of pairing between *N.* [illegible] as well as *N. gossei* with the species [illegible]. This points to a close genotypic homology between *N. gossei* and *N. amplexicaulis*. This is further proved by the complete pairing and fertility of the hybrid between the two species. The pairing relationship between *N. amplexicaulis* and the other species is shown in Fig. 1.

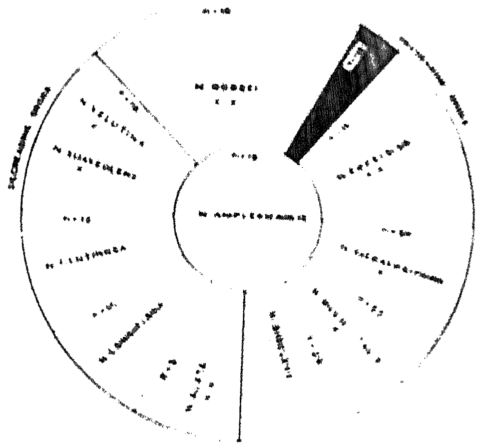


FIG. 1. Chart indicating *N. amplexicaulis* crosses with other species of *Nicotiana*. [illegible] indicates goodness and [illegible] indicates failure. First symbol for chromosome pairing and second symbol for pollen and seed fertility. The striped portion will be the cytogenetic location for *N. amplexicaulis*.

reveals another interesting feature. With certain species, the chromosome pairing was excellent but genetic abortion resulted in complete sterility both on the male and female sides. This is indicated in Fig. 1. The symbol + or − below the specific name indicates the chromosome pairing or its failure. The first symbol indicates pairing while the second symbol, goodness or failure of pollen and seed fertility as a consequence thereof. It may be seen from Fig. 1 that besides *N. gossei*, both pairing and fertility was obtained only in crosses with *N. excelsior* and *N. alata*. In the case of *N. excelsior*, no morphological similarity can be seen with *N. amplexicaulis*. Consequently, the derivatives from this cross looked quite different from either of the parents. Based on the inclusion or elimination of the extra *excelsior* chromosome, F_2 and F_3 generation also threw out different type of segregants.

With regard to the cross between *N. amplexicaulis* and other members of the Suaveolentes section, namely, *N. megalosiphon*, *N. occidentalis*, *N. velutina* and *N. suaveolens*, though chromosome pairing was excellent, fertility of the hybrids had been completely impaired. Considering all these facts of cytogenetic interest, it may not be improbable to fix *N. amplexicaulis* cytogenetically between *N. gossei* and *N. excelsior* as represented in Fig. 1. With regard to the complete pairing and fertility of the hybrid between *N. amplexicaulis* and *N. alata*, it is quite intriguing that a distant inter-sectional species, like *N. alata*, should have a very close affinity with *N. amplexicaulis*. Morphologically, these two species are poles apart. However, *N. gossei* and *N. alata* do not show such affinity (*vide* Table I). So it can be inferred that in the origin of *N. amplexicaulis* genotype, a greater expression of chromosomal homology derived from *N. alata* is amply evident. In this respect only, *N. amplexicaulis* differs from *N. gossei*. With species of other section, the hybrids were always sterile (Table I).

TABLE I

Chromosome pairing in interspecific hybrids involving either N. gossei *or* N. amplexicaulis *as one of the parents*

Cross*	Range of bivalent formation during meiosis in the hybrids	
	N. gossei†	*N. amplexicaulis*‡
1. *N. velutina* ($n=16$) ..	15 to 16	15 to 16
2. *N. suaveolens* ($n=16$) ..	13 to 15	15 to 16
3. *N. excelsior* ($n=19$) ..	17 to 18	17 to 18
4. *N. megalosiphon* ($n=20$)	13 to 17	17 to 18
5. *N. occidentalis* ($n=21$)	13 to 15	17 to 18
Inter-sectional hybrids:		
6. *N. glutinosa* ($n=12$) ..	..	3 to 7
7. *N. alata* ($n=9$) ..	0 to 3	12 to 13
8. *N. longiflora* ($n=10$) ..	0 to 3	0 to 3
9. *N. bigelovii* ($n=24$) ..	..	4 to 10

* The direction of cross not indicated.
† Reference : Goodspeed (1954).
‡ Reference : Gopinath *et al.* (1965).

As for the origin of *N. amplexicaulis*, it is found very difficult to determine through chromosome homology since the chromosomes of *N. amplexicaulis* freely paired with most of its sectional species. So test crosses did not give any clear indication. Overlapping as they do in geographical distribution, *N. gossei* and *N. excelsior* might have also hybridised and given rise to *N. amplexicaulis* type of plants. But the contrasting leaf and flower characters of the above species would scarcely support such an assumption. Further, flowers of *N. amplexicaulis* have little similarity with those of *gossei* or *excelsior*. Taxonomically *N. excelsior* is far below *N. amplexicaulis* in classification. The discovery of *N. amplexicaulis* as late as 1960 might indicate that it would have arisen as a hybridised product of the modern Australian species.

---

1. Burbidge, Nancy T., *Aust. J. Botany*, 1960 **8**, 342.
2. Goodspeed, T. H., *Chronica Botanica*, Mass., 1954.
3. Gopinath, D. M., Krishnamurthy, K. V. and Krishnamurthy, A. S., *Can. J. Genet. Cytol.*, 1965, **7**, 328.

(Fig. 2). The pollen sterility was higher in tetrasomics than trisomics. Two tetrasomic types had fruits with normal size and shape, with much reduced seed size (75%) and the seed number of each fruit was half of the diploid cultivar.

Fruit shape was mostly deformed in hyper-triploid, hypo-triploid and triploid types, probably because of high ovule sterility. It was found that tolerable limit of extra chromosome in case of guava was four, beyond this limit seed fertility and fruit shape was found to be adversely affected.

As guava is vegetatively propagated, the aneuploid types can very well be maintained, unlike annual crop plants. The addition of two chromosomes to diploid number has shown a great promise in guava improvement. This method of breeding can very well be adopted in tree fruits where numerous seeds decrease the fruit value.

---

1. Blakeslee, A. F. and Belling, J., *Amer. Nat.*, 1924, **56, 16.**
2. Love, D. and Nadeau, L., *Canad. J. Genet. Cyt.*, 1961, **3,** 289.

A NOTE ON THE CYTOGENETIC STATUS OF *NICOTIANA AMPLEXICAULIS* BURBIDGE

D. M. GOPINATH, K. V. KRISHNAMURTHY AND A. S. KRISHNAMURTHY
Central Tobacco Research Institute, Rajahmundry, A.P.

WHILE assigning taxonomical positions for the five new Australian species of *Nicotiana*, Burbidge (1960) fixed *N. amplexicaulis* ($2n = 36$) between *N. gossei* ($2n = 36$) and *N. maritima* ($2n = 32$). Morphologically, *N. amplexicaulis* may well be regarded as a mini copy of *N. gossei* but bears little resemblance to *N. maritima.* Distributionally, the three species are widely separated, *N. gossei* in Central Australia, *N. amplexicaulis* in Queensland and *N. maritima* in South Australia. According to Goodspeed (1954) almost all the Australian species had their origin through amphidiploidy followed by chromosomal and genetic reorganisation. Aneuploidy through loss of chromosomes played an important part in the evolution of the Australian species in particular. In this context, the cytogenetic position of *N. amplexicaulis* was investigated to determine its relationship to the older species. For this purpose, inter- and intrasectional crosses between *N. amplexicaulis* and certain species of *Nicotiana* were done and the cytology of the hybrids followed. Since *N. amplexicaulis* is similar to *N. gossei* in chromosome number and also in morphology, comparison of chromosome behaviour of crosses between *N. gossei* and the same species involved in *N. amplexicaulis* crosses was made. The trend of cytogenetic behaviour of *N. gossei* and *N. amplexicaulis* is almost similar.

The chromosome pairing of *N. gossei* and *N. amplexicaulis* is given in Table I. From Table I it may be seen that a high degree of pairing between *N. amplexicaulis* as well as *N. gossei* with the species is evident. This points to a close genotypic homology between *N. gossei* and *N. amplexicaulis.* This is further proved by the complete pairing and fertility of the hybrids between the two species. The pairing relationship between *N. amplexicaulis* and the other species, as listed in Fig. 1,

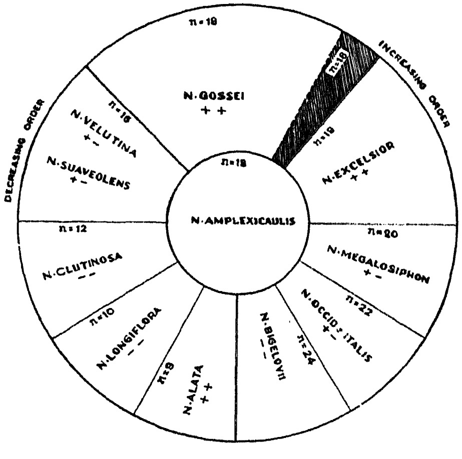


FIG. 1. Chart indicating *N. amplexicaulis* crosses with other species of *Nicotiana.* + indicates goodness and − indicates failure. First symbol for chromosome pairing and second symbol for pollen and seed fertility. The striped portion will be the cytogenetic location for *N. amplexicaulis.*

reveals another interesting feature. With certain species, the chromosome pairing was excellent but genetic abortion resulted in complete sterility both on the male and female sides. This is indicated in Fig. 1. The symbol + or − below the specific name indicates the chromosome pairing or its failure. The first symbol indicates pairing while the second symbol, goodness or failure of pollen and seed fertility as a consequence thereof. It may be seen from Fig. 1 that besides *N. gossei*, both pairing and fertility was obtained only in crosses with *N. excelsior* and *N. alata*. In the case of *N. excelsior*, no morphological similarity can be seen with *N. amplexicaulis*. Consequently, the derivatives from this cross looked quite different from either of the parents. Based on the inclusion or elimination of the extra *excelsior* chromosome, F_2 and F_3 generation also threw out different type of segregants.

With regard to the cross between *N. amplexicaulis* and other members of the Suaveolentes section, namely, *N. megalosiphon*, *N. occidentalis*, *N. velutina* and *N. suaveolens*, though chromosome pairing was excellent, fertility of the hybrids had been completely impaired. Considering all these facts of cytogenetic interest, it may not be improbable to fix *N. amplexicaulis* cytogenetically between *N. gossei* and *N. excelsior* as represented in Fig. 1. With regard to the complete pairing and fertility of the hybrid between *N. amplexicaulis* and *N. alata*, it is quite intriguing that a distant inter-sectional species, like *N. alata*, should have a very close affinity with *N. amplexicaulis*. Morphologically, these two species are poles apart. However, *N. gossei* and *N. alata* do not show such affinity (*vide* Table I). So it can be inferred that in the origin of *N. amplexicaulis* genotype, a greater expression of chromosomal homology derived from *N. alata* is amply evident. In this respect only, *N. amplexicaulis* differs from *N. gossei*. With species of other section, the hybrids were always sterile (Table I).

TABLE I

Chromosome pairing in interspecific hybrids involving either N. gossei *or* N. amplexicaulis *as one of the parents*

Cross*	Range of bivalent formation during meiosis in the hybrids	
	N. gossei†	*N. amplexicaulis*‡
1. *N. velutina* (*n*=16) ..	15 to 16	15 to 16
2. *N. suaveolens* (*n*=16) ..	13 to 15	15 to 16
3. *N. excelsior* (*n*=19) ..	17 to 18	17 to 18
4. *N. megalosiphon* (*n*=20)	13 to 17	17 to 18
5. *N. occidentalis* (*n*=21)	13 to 15	17 to 18
Inter-sectional hybrids:		
6. *N. glutinosa* (*n*=12) ..	..	3 to 7
7. *N. alata* (*n*=9) ..	0 to 3	12 to 13
8. *N. longiflora* (*n*=10) ..	0 to 3	0 to 3
9. *N. bigelovii* (*n*=24) ..	..	4 to 10

* The direction of cross not indicated.
† Reference : Goodspeed (1954).
‡ Reference : Gopinath *et al.* (1965).

As for the origin of *N. amplexicaulis*, it is found very difficult to determine through chromosome homology since the chromosomes of *N. amplexicaulis* freely paired with most of its sectional species. So test crosses did not give any clear indication. Overlapping as they do in geographical distribution, *N. gossei* and *N. excelsior* might have also hybridised and given rise to *N. amplexicaulis* type of plants. But the contrasting leaf and flower characters of the above species would scarcely support such an assumption. Further, flowers of *N. amplexicaulis* have little similarity with those of *gossei* or *excelsior*. Taxonomically *N. excelsior* is far below *N. amplexicaulis* in classification. The discovery of *N. amplexicaulis* as late as 1960 might indicate that it would have arisen as a hybridised product of the modern Australian species.

---

1. Burbidge, Nancy T., *Aust. J. Botany*, 1960 **8**, 342.
2. Goodspeed, T. H., *Chronica Botanica*, Mass., 1954.
3. Gopinath, D. M., Krishnamurthy, K. V. and Krishnamurthy, A. S., *Can. J. Genet. Cytol.*, 1965, **7**, 328.

LETTERS TO THE EDITOR

EFFECT OF CONCENTRATION ON FLUORESCENCE SPECTRUM OF FLUORESCEIN

THE fluorescence spectrum of fluorescein as reported by earlier investigators (Forster *et al.*, 1962),[1] has only one peak at $\lambda \sim 5270$ Å. These measurements were carried out for very low concentrations of fluorescein. This peak may therefore be due to fluorescein dianions. The corresponding absorption peak is reported at $\lambda \sim 4900$ Å (Gutsze *et al.*, 1963).[2] It is also found that for these concentrations the fluorescence yield obeys Perrin's formula (Pringsheim, 1949).[4] Fluorescein in solution can exist in different ionic and in various states of molecular aggregation, *e.g.*, it can exist as neutral molecule, monoanion, dianion and dimers of dianion, etc. In a given solution the proportion of each variety will depend upon the concentration of the fluorescein, and hence a change may be expected in the fluorescence spectrum with varying concentration. The present study was undertaken to study fluorescence spectrum for higher concentrations and also to check the validity of the Perrin's formula under these conditions.

The fluorescent substance used is sodium fluorescein and its spectrum is recorded with a Hilger's constant deviation spectrograph and scanned with a recording microphotometer. The total fluorescence intensity is measured using the arrangement employed in our earlier investigations (J. Kishore *et al.*, 1962).[3]

The effect of increasing the concentration of fluorescein in the solution on the fluorescence spectra is shown in Fig. 1. Here the concentration for the curve-marked 1 < for the curve-marked 2 < for the curve-marked 3. The fluorescence spectrum for the concentration $\sim 0 \cdot 25 \times 10^{-4}$ g/cc (curve 1) has two maxima at $\lambda \sim 5300$ Å and $\lambda \sim 5650$ Å.* With increasing concentration the intensity of the peak at $\lambda \sim 5650$ Å increases, while the intensity of the peak at $\lambda \sim 5300$ Å decreases and almost completely disappears for concentrations $\geqslant 10^{-3}$ g/cc (curve 3). This maximum at $\lambda \sim 5300$ Å also shifts towards longer wavelength side with the increase in concentration. The absorption spectrum of fluorescein, reported by earlier workers, has two peaks at $\lambda \sim 4900$ Å and $\lambda \sim 4600$ Å. These two peaks are due to dianions and monoanions respectively according to Gutsze *et al.* (1963).[2] We have also obtained these two peaks and our absorption measurements for different concentrations, indicate that the relative intensity of the peak at $\lambda \sim 4600$ Å increases rapidly with increasing concentration.

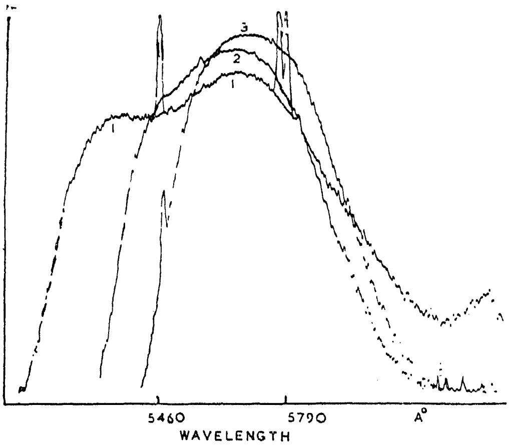


FIG. 1. Microphotometer record of the fluorescence spectrum at different concentration: (1) $2 \cdot 5 \times 10^{-5}$ g/cc. (2) $2 \cdot 5 \times 10^{-4}$ g/cc. (3) 1×10^{-3} g/cc.

The fluorescence peak reported earlier[1] at $\lambda \sim 5270$ Å coincides with our peak on the shorter wavelength side. Now, as the intensities of the two peaks at $\lambda \sim 5650$ Å and $\lambda \sim 5300$ Å are comparable, the possibility of the former being interpreted as due to phosphorescence can be ruled out. The peak at lower concentration is due to predominance of the fluorescein dianions and the origin of the peak at $\lambda \sim 5650$ Å can be accounted for by considering the formation of either monoanions or dianion dimers, at higher concentrations of fluorescein. This view is further supported by the results obtained from the measurement of total fluorescence intensity, for concentrations varying from 2×10^{-7} g/cc to 2×10^{-3} g/cc, with two different exciting wavelengths $\lambda \sim 4358$ Å and $\lambda \sim 5460$ Å. This type of measurements has been reported by us earlier.[3]

In the present case we find that with exciting wavelength $\lambda \sim 5460$ Å, the maximum of the intensity curve lies in the concentration region $\sim 10^{-3}$ g/cc, while with the exciting wavelength $\lambda \sim 4358$ Å the maximum of the intensity curve is broadened and lies in the concentration region from 10^{-4} g/cc to 10^{-3} g/cc. This is possible because $\lambda \sim 4358$ Å excites both the dianions as well as monoanions or dianion dimers giving a broad peak, but $\lambda \sim 5460$ Å excites only the monoanions or dianion dimers which are in more abundance in the higher concentration region. The shift and disappearance of dianion peak at higher concentrations may be due to quenching and reabsorbtion of dianion fluorescence by dianion or monoanions.

As $\lambda \sim 4358$ Å excites both the types of fluorescing units, it appears that the Perrin's formula for the fluorescence yield may not hold good. But the measurements indicate that the agreement between the experimental results and Perrin's formula is fairly good. However, this can be explained, if we assume that, the number of dianion dimers or monoanions formed is proportional to the concentration of the dye, and the fluorescence radiation emitted by dianions is completely absorbed.

Dept. of Physics and M. K. Machwe.
Astrophysics,
Delhi University,
Delhi-7, *April* 13, 1970.

---

* The sharp peaks at $\lambda \sim 5460$ Å, 5769Å and 5790Å are due to scattered mercury spectrum.

1. Forster, Laslie, S. and Dudley, Daniel, *J. Phys. Chem.*, 1962, **66**, 838.
2. Gutsze, A. and Walerys, H., *Chemical Abstracts*, 1963, **59**, 4688.
3. Kishore, J., Machwe, M. K., Gopal Krishnan, K. and Chaudhuri, K. D., *Ind. J. Phys.*, 1962, **36**, 415.
4. Pringsheim, P., *Fluorescence and Phosphorescence*, 1949.

SEASONAL VARIATION OF THE DELAYS BETWEEN SPREAD F AND MAGNETIC ACTIVITY AT AHMEDABAD

Briggs[1] and Kumar *et al.*[2] have reported that the variations of occurrences of spread F echoes lag behind the variations of K index and that this lag varies with sunspot activity. In a recent communication Raju and Rao[3] have studied the latitude variation of these delays and observed that the maximum delay which occurs during the sunspot minimum period for low latitude stations shifts systematically towards sunspot maximum with increase of latitude.

In view of the definite time delay observed between spread F and magnetic activity it is felt worthwhile to study whether there is any seasonal variation of these delays. For this purpose the data for the low latitude station Ahmedabad (23° N. Geog. Lat.) for the period 1957–64 have been analysed after dividing into three seasons, namely, equinox (March, April, September and October), summer (May, June, July and August) and winter (November, December, January and February). K indices values are obtained from the Alibag (18·3° N. Geog. Lat.) magnetic observatory. Nearly 100 observations are taken for each season for the analysis.

Figure 1 shows the variations of the parameters τ_0, $\rho(\tau_0)$ and $\rho(0)$ for the three seasons from 1957 to 1964. It can be seen that the delay generally increased with decreasing sunspot activity for equinoxes and winter and that during summer the delay showed a prominent decrease with decreasing sunspot activity. This reversal of the delay for the low latitude station Ahmedabad during summer is an important result of the present investigation.

The maximum correlation coefficient $\rho(\tau_0)$ becomes positive during 61–62 for equinox. But during summer it is interesting to see that the correlation is generally positive during sunspot maximum period and becomes negative during sunspot minimum period. During winter it is negative in all the years except 1963. It is to be noted that this significant positive correlation at sunspot maximum during summer is revealed only when large delay τ_0 is introduced.

The direct correlation $\rho(0)$ values are insignificant during sunspot minimum period for equinox and winter whereas they are significant at sunspot minimum and insignificant at sunspot maximum during summer. These insignificant values become significantly large when the appropriate delays are introduced.

Several workers have studied the effect of magnetic activity on spread F for the different seasons by direct comparison without allowing for a possible time lag and as such the results obtained in the present study cannot be directly compared with them. However, it can be seen whether the earlier studies without introducing time delay agree with the present findings. Lyon *et al.*[4] have shown from a study of large number of stations that the magnetic activity has a negative effect on equatorial spread F incidence which is more in equinoxes and winter and less in summer indicating the reduced magnetic control on spread F during summer for the period 1957–58. Rangaswamy and Kapasi[5] have reported maximum reduction

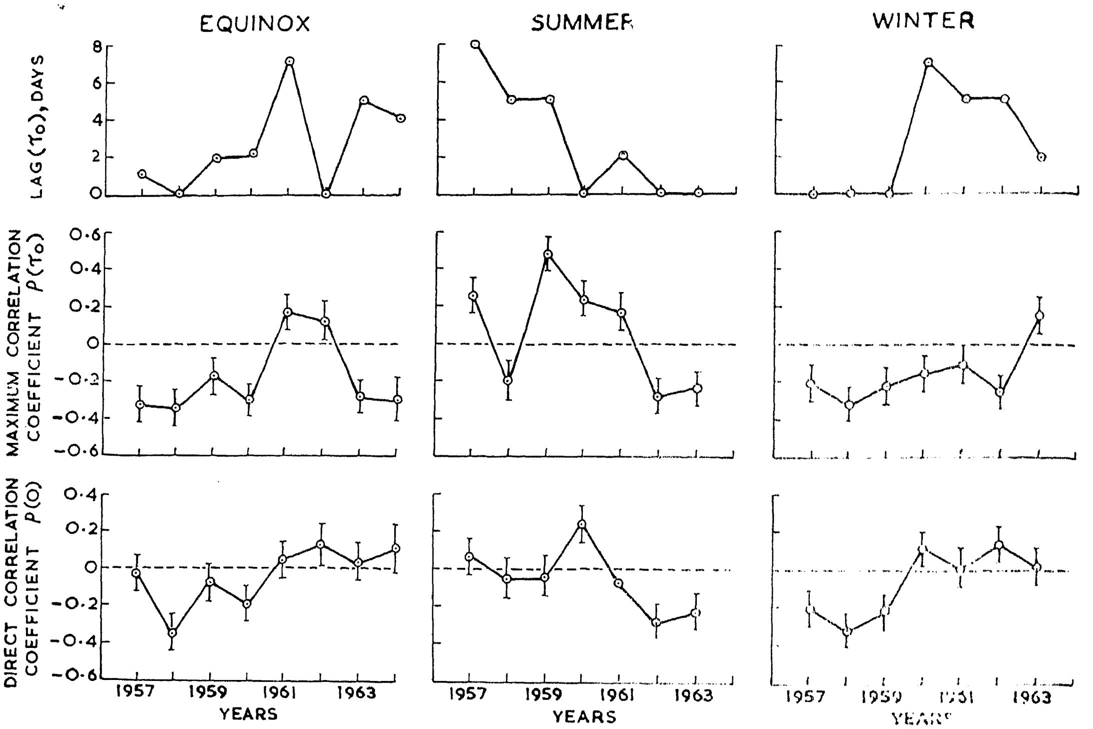


FIG. 1. Variation of the quantities τ_0, ρ (τ_0) and ρ (0) for the period 1957-64.

of equatorial spread F due to geomagnetic activity in equinoxes and less reduction in summer during the high sunspot years from a study of six Indian stations. Wright *et al.*[6] have arrived at a similar conclusion from their studies on equatorial spread F from six low latitude African stations. Rao and Mitra[7] also reported an inverse correlation between spread F incidence and geomagnetic activity for Trivandrum during the high sunspot period which has a seasonal variation, being maximum at equinoxes and minimum in summer. The above results agree well with the present investigation for sunspot maximum as seen from $\rho(0)$ plots. The insignificant correlation observed by all the above workers during summer is to be attributed to the large delay during sunspot maximum.

The most interesting result which is noticed in the present investigation is that while the delay increased with decreasing sunspot cycle for low latitude stations, Ahmedabad showed opposite variation in summer, namely, decreasing delay with decreasing sunspot cycle. During the same season $\rho(\tau_0)$ values which showed a significant positive correlation during almost all the years of sunspot maximum, changed to negative during sunspot minimum years, whereas it is negative throughout the sunspot cycle in other seasons.

One of the authors (P. T. S. R.) is grateful to the Council of Scientific and Industrial Research for financial assistance.

Ionosphere Res. Labs., P. T. SANYASI RAJU.
Physics Department, B. RAMACHANDRA RAO.
Andhra University,
Waltair, *March* 24, 1970.

---

1. Briggs, B. H., *J. Atmosph. Terr. Phys.* 1965, **27**, 991.
2. Jagath Kumar, V. R., Sanyasi Raju, P. T. and Ramachandra Rao, B., *Ibid.*, 1967, **29**, 1669.
3. Sanyasi Raju, P. T. and Ramachandra Rao, B., *Ibid.*, 1969, **31**, 869.
4. Lyon, A. J., Skinner, N. J. and Wright, R. W. H., *Ibid.*, 1960, **19**, 145.
5. Rangaswamy, S, and Kapasi, K. B., *Ibid.*, 1963, **25**, 721.
6. Wright, R. W. H. and Skinner, N. J., *Ibid.*, 1959, **15**, 121.
7. Rao, C. V. S. and Mitra, S. N., *J. Geophys. Res.*, 1962, **67**, 127.

QUANTITATIVE SEPARATION OF CALCIUM, PHOSPHATE AND SILICATE

THE need for a rapid and accurate quantitative separation of calcium, phosphate and silicate was felt to study the kinetics of $PO_4^{3-} \rightleftharpoons SiO_4^{4-}$ exchange on hydroxylapatite, $3\ Ca_3(PO_4)_2.Ca(OH)_2$, the primary inorganic constituent of human bones and teeth. The earlier methods[1-3] used for the separation of pairs of these ions failed in the presence of the third and hence the investigation described below was undertaken.

Calcium was first separated as oxalate, dissolved in hydrochloric acid and determined complexometrically. Phosphate was separated as ammonium molybdophosphate, dissolved in sodium hydroxide, re-precipitated as magnesium ammonium phosphate and magnesium determined complexometrically. Silicate was determined gravimetrically as quinoline molybdosilicate.

The chemicals used were of A. R. (BDH) grade. The solutions were prepared in double-distilled water tested previously for the absence of Ca^{2+} and SiO_4^{4-} and preserved in polyethylene containers. Standard solutions of Ca^{2+} and PO_4^{3-} were prepared using calcium carbonate and potassium dihydrogen phosphate respectively while that of SiO_4^{4-} was prepared as described below:

About 3 g. of silicon dioxide previously heated to constant weight at 900° C. were mixed with ~ 12 g. of sodium carbonate and heated in a graphite crucible to 1000° C. for 4 hr. in an atmosphere of nitrogen. The fused mass was treated with ~ 5 M hydrochloric acid to neutralise the surplus sodium carbonate, the evolved carbon dioxide being driven out by slight warming. The solution was made up to 500 ml. and the silicate content determined.[4]

To a sample solution containing known convenient amounts of calcium, phosphate and silicate (*see* Table I), 3 to 4 drops of thymol blue indicator were added and calcium oxalate was precipitated by the addition of an excess of 0·5 M oxalic acid solution, the appropriate pH being brought about by dropwise addition of 1·0 M ammonium hydroxide till the solution turned yellow. The presence of excess of oxalic acid was confirmed by the absence of further precipitation on the addition of a few more drops of it. The precipitate was digested for 1 hr. on a water-bath and separated by filtration through a 1G4 crucible. It was washed with 1% ammonium oxalate till it was free from phosphate and silicate. It was dissolved in warm ~ 5 M hydrochloric acid and made up to a known volume. A convenient volume of this solution was treated with an excess of 0·01 M magnesium complexonate and titrated against standard 0·01 M EDTA at pH ~ 10 using Eriochrome Black T as indicator.

To the filtrate containing phosphate and silicate, ~ 5 ml. of nitric acid (sp. gr. 1·42) and ~ 10 ml. of 8% ammonium nitrate were added. Phosphate was precipitated at ~ 50° C. as ammonium molybdophosphate by adding 10% ammonium molybdate until no further formation of yellow precipitate from the supernatant liquid was perceptible. The precipitate was filtered through a 1G4 crucible and washed with a solution containing equal volumes of 1% ammonium nitrate and 20% nitric acid (sp. gr. 1·42) till it was free from silicate. The precipitate was dissolved in the minimum volume of 0·1 M sodium hydroxide. The solution was treated with ~ 4 drops of thymol blue indicator followed by the addition of ~ 6 M hydrochloric acid till it turned deep yellow. Phosphate was precipitated as magnesium ammonium phosphate by adding an excess of 0·5 M magnesium chloride, the appropriate pH being obtained by the dropwise addition of 9 M ammonium hydroxide till the solution turned blue. The precipitate was separated by filtration through a 1G4 crucible and washed with 0·4 M ammonium hydroxide till it was free from Mg^{2+}. The precipitate was dissolved in ~ 5 M hydrochloric acid and made up to a known volume. To a convenient volume of

TABLE I

Quantitative separation of calcium, phosphate and Silicate

Trial No.	Calcium Weight, mg. Theo	Calcium Weight, mg. Exptl	% Error	Phosphate Weight, mg. Theo.	Phosphate Weight, mg. Exptl.	% Error	Silicate Weight, mg Theo.	Silicate Weight, mg Exptl.	% Error
1	100·200	99·400	0·80	142·500	142·500	0·00	41·010	41·700	1·68
2	80·160	79·400	0·95	95·000	95·000	0·00	32·810	32·430	1·29
3	48·096	47·800	0·62	57·020	57·020	0·00	24·610	24·820	0·85

this solution excess of standard 0·01 M EDTA was added and the excess back-titrated against standard 0·01 M magnesium chloride.

The final filtrate containing the soluble molybdosilicate complex and the unreacted orthosilicate was treated with ~ 25 ml. of 10% ammonium molybdate, brought to the appropriate pH for the precipitation of quinoline molybdosilicate by the addition of hydrochloric acid (sp. gr. 1·18) till the solution turned distinctly red. The precipitation was brought about by the dropwise addition of ~ 2% quinoline accompanied by constant stirring. The presence of excess of quinoline and ammonium molybdate was confirmed by the absence of further precipitation from the supernatant liquid on the addition of a few more drops of these reagents. The precipitate was digested at ~ 70° C. for ~ 10 minutes. It was cooled in an ice-bath, filtered through a weighed 1G4 crucible, washed with 0·05% quinoline till it was free from molybdate ions, dried at 130° C. and weighed as the dihydrate.

Three representative sets of results with solutions of known concentrations of Ca^{2+}, PO_4^{3-} and SiO_4^{4-} are given in Table I. The method was found to be quick and accurate; successive determinations of the three ions from the same aliquot could thus be achieved.

The authors thank Prof. G. B. Singh, Head of the Chemistry Department, Banaras Hindu University, for providing facilities. Financial assistance given to one of us (R. P. S.) by CSIR is also gratefully acknowledged.

Dept. of Chemistry, T. S. B. NARASARAJU.
Banaras Hindu Univ., R. P. SINGH.
Varanasi, V. L. N. RAO.
February 10, 1970.

1. Singh, R. P., Chickerur, N. S. and Narasaraju, T. S. B., *Z. anal. Chem.*, 1968, **237**, **117**.
2. Macdonald, A. M. G. and Van Der Voort, F. H., *Analyst*, 1968, **93**, 65.
3. Scott, W. W. and Furman, N. H., *Standard Methods of Chemical Analysis*, The Technical Press Ltd., London, 1956, **1**, 208.
4. Wilson, C. L. and Wilson, D. W., *Comprehensive Analytical Chemistry*, Elsevier Publishing Co., London, 1962, **1** (**C**), 156.

NEW TETRACYCLIC TRITERPENES FROM *FOMES SENEX*: SENEXONOL, SENEXDIONE, OXIDOSENEXONE AND SENEXDIOLIC ACID

THE wood-rotting fungus *Fomes senex* Nees & Mont. has been chemically examined further.[1] Besides the known compounds pinicolic acid A (VI *a*) and trametenolic acid B (VI *b*), four new compounds have been isolated: a tetracyclic triterpene acid, senexdiolic acid ($C_{30}H_{48}O_4$) and three neutral nor-triterpenes, senexonol ($C_{29}H_{46}O_2$), senexdione ($C_{29}H_{44}O_2$) and oxidosenexone ($C_{29}H_{46}O_2$). They are all interrelated. Senexonol is a ketoalcohol and senexdione the corresponding diketone. Acid treatment of senexonol gives rise to an isomeric compound in which the alcoholic function and an isopropylidene double bond in the side chain disappear simultaneously giving rise to a cyclic ether (a tetrahydrofuran derivative) which may be called 'oxidosenexone' and which is present as a minor compound in the fungus. Senexdiolic acid is a dihydroxy acid in which the acidic function is β- to one of the hydroxyls, since oxidation of this hydroxyl group to keto leads to decarboxylation. The nor-product obtained in this manner starting from the acid isomerisation product (V) of senexdiolic acid was identical with oxidosenexone. All the compounds contain an 8 : 9 double bond. A number of chemical transformations, taken together with U.V.,

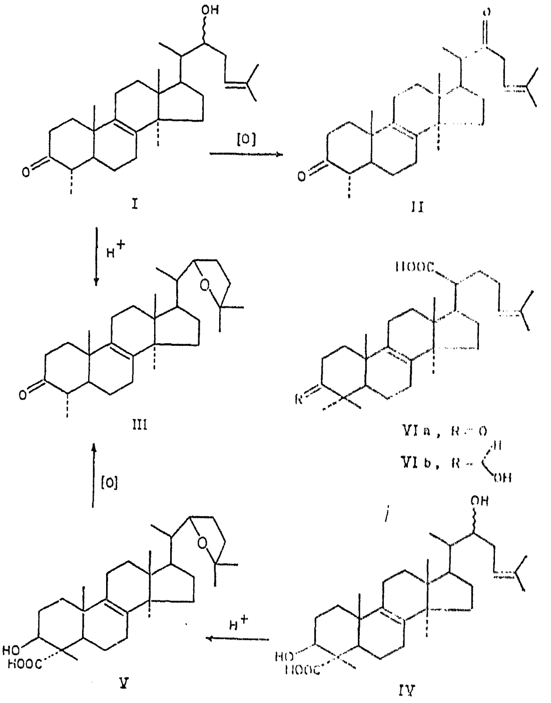


FIG. 1

I.R., N.M.R. and mass spectral data, and the correlation of senexdiolic acid with trametenolic acid B (VI b) lead to the structure (I)* for senexonol, (II) for senexdione, (III) for oxidosenexone and (IV) for senexdiolic acid. The co-occurrence of (I) and (IV) is of interest in connection with the mode of formation of sterols from tetracyclic triterpenes.

The authors thank Prof. T. R. Seshadri for his kind interest.

Dept. of Chemistry, A. K. Batta.
University of Delhi, S. Rangaswami.
Delhi-7, *April* 25, 1970.

---

* This structure supersedes the one proposed earlier.

1. Batta, A. K. and Rangaswami, S., *Ind. J. Chem.*, 1969, **7**, 1063.

SYNTHESES OF 4-(2′-THIENYL)- AND 4-(2′-FURYL)-THIAZOLES

2-Methyl- or 2-amino-4-alkyl or aryl thiazole derivatives which are of industrial and biological importance have been studied extensively. But relatively few compounds containing this ring with heterocyclic nuclei as substituents at position-4 are known and therefore it was considered of interest to synthesise a few 2-amino- and 2-methyl thiazoles with α-thienyl and α-furyl substituents at position-4.

Experimental

2-Methyl-4-(2′-thienyl)-thiazole methiodide

The intermediate bromomethyl-2-thienyl ketone required for the purpose was obtained by treating 2-acetyl thiophene[1] with calculated quantity of bromine in chloroform medium. The resulting bromo-ketone was then refluxed with thioacetamide (1·2 mole) in absolute ethanol for 2 hours. Excess of alcohol was removed under reduced pressure and on adding very dilute ammonium hydroxide solution, a yellow oil separated out. The oil was extracted with ether, the ether extract was washed with water and then dried over anhydrous magnesium sulphate. After removing ether, the oil was heated with methyl-iodide (1·2 mole) in a sealed tube for 6 hours at 100° C. The solid methiodide, thus obtained, was recrystallised from absolute ethanol.

2-Methyl-4-(2′-furyl)-thiazole methiodide was prepared similarly from 2-acetyl furan.[2]

2-Amino- and 2-phenylamino derivatives of the above-mentioned thiazoles were obtained by condensation of the corresponding bromo-ketones with thiourea and phenyl thiourea respectively and the compounds were isolated in usual manner.

The analytical data and m.p., etc., of all these compounds are described in Table I.

Table I

4-(2′-Thienyl)- and 4-(2′-furyl) thiazole derivatives

Name of thiazole derivatives	MP °C.	Yield %	Percentage sulphur	
			Found	Calc.
4-(2′-Thienyl)-2-methyl-thiazole methiodide	189	70	19·63	19·81
4-(2′-Furyl)-2-methyl-thiazole methiodide	218(*a*)	65	10·27	10·43
4-(2′-Thienyl)-2-amino thiazole	128	70	35·01	35·16
4-(2′-Thienyl)-2-phenyl-aminothiazole	112	50	24·48	24·80
4-(2′-Furyl)-2-amino thiazole	117	60	18·82	19·27
4-(2′-Furyl)-2-phenyl-aminothiazole	107	45	12·81	13·22

Department of Chemistry, S. P. Misra.
Utkal University, P. K. Jesthi.
Bhubaneswar-4, Vani-Vihar,
Orissa, *April* 11, 1970.

---

1. Johnson, *J. Am. Chem. Soc.*, 1947, **69**, 150.
2. Hartough and Kosak, *Ibid.*, 1947, **69**, 1012.

LEONHARDITE FROM A GRANITIC PEGMATITE IN NELLORE DISTRICT, ANDHRA PRADESH

During a systematic study of the mineralogy of the Nellore granitic pegmatites of Andhra Pradesh, leonhardite (a partly dehydrated variety of laumontite) is found to occur in cavities, measuring about 4 cm. in diameter, located in albite of a granitic pegmatite, situated at a distance of about 400 metres west of Nityakalyani mica mine in the Nellore District of Andhra Pradesh. The mineral is white in colour and is pulverulent. It shows good (010) and (110) cleavages. The sign of elongation of the mineral is both positive and negative. The mineral is analysed by an adaptation of the method of Shapiro and Brannock[1] and the chemical and optical data of the mineral are furnished in Table I.

From the chemical data, it is seen that the mineral is essentially a calcium end-member, with a small amount of alkalies. According to Coombs,[2] the solid solution between the calcium and sodium end-members of laumontite may be both of the plagioclase type, in which Na and Si atoms simultaneously act as proxy for Ca and Al atoms, and of the zeolitic type, in which two alkali atoms replace one of Ca. The chemical analysis suggests that the solid solution between the two end-members of the

TABLE I

Chemical and optical data of leonhardite

	1		2	
SiO_2	51·21	Si	15·73	23·88
Al_2O_3	22·37	Al	8·11	
Fe_2O_2	0·10	Fe^{+3}	0·04	
MgO	*nd*	Na	0·70	4·66
CaO	11·68	Ca	3·85	
Na_2O	1·20	K	0·11	
K_2O	0·25	H_2O	14·14	
H_2O^+ H_2O^-	13·76			
	100·57			

N_x =1·503 $2V_x$ =44°

N_y =1·512 $Z:c$ =33°

N_z =1·514 $N_z - N_x$ = 0·011

1. Leonhardite. Analyst: R. Jagadiswara Rao.
2. Number of ions on the basis of 48 oxygens.

mineral is essentially of zeolitic type. The low concentration of water in the mineral indicates that it is leonhardite, a partly dehydrated variety of laumontite.

Cavities, many of them lined with euhedral crystals, are abundant in many pegmatites of the world.[3] Detailed studies of the Nellore granitic pegmatites by the author indicated that cavities are extremely rare in them. Cavities in pegmatites may be primary or secondary. The cavities found in the Nellore granitic pegamatites are secondary in origin, formed from selective removal of mineral matter from single crystals like albite under hydrothermal conditions. The formation of laumontite at the expense of albite can be visualised by a large-scale substitution of Na in albite by Ca in hydrothermal solutions. The dehydration of laumontite, leading to the formation of leonhardite, might have been caused by simple exposure of the mineral to the atmosphere.[4]

The author wishes to thank Professor M. G. Chakrapani Naidu for guidance and encouragement.

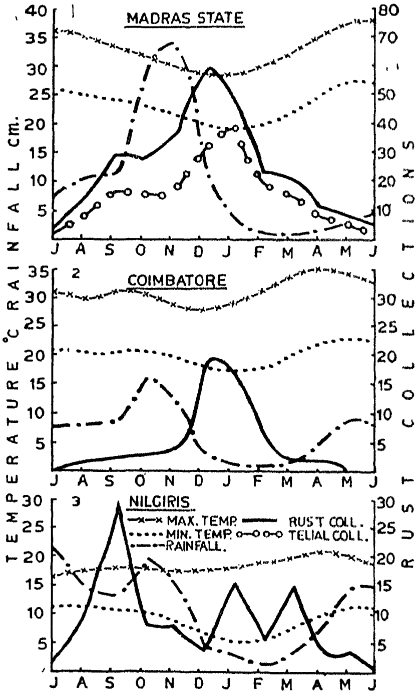
Dept. of Geology, R. JAGADISWARA RAO.
Sri Venkateswara Univ.,
Tirupati, *April* 8, 1970.

---

1. Shapiro, L. and Brannock, W. W., *U.S. Geol. Surv. Bull.*, 1956, 1036 *c*.
2. Coombs, D. S., *Amer. Min.*, 1952, **37**, 812.
3. Jahns, R. H., *Eco. Geol. 50th Anniv. Vol.*, 1955, p. 1099.
4. Deer, W. A., Howie, R. A. and Zussman, J., *Rock Forming Minerals*, 1963, 4.

SEASONAL DISTRIBUTION OF RUST FUNGI

THERE have been few studies on the seasonal occurrence of fungi except those concerned with species causing important crop diseases. During a monographic study of the Pucciniaceæ of Madras State (8°-14° N. latitude) it was considered interesting to tabulate the collections of these fungi according to the months of their collection and examine whether any clear pattern would emerge about their seasonal occurrence. Rust fungi have been largely collected in the State around Coimbatore (11° N. latitude), the Nilgiris mountains and the Walayar forests and stray collections from other areas. The collections are spread over from the beginning of this century to the present day. The distribution of the collections was examined with reference to the rainfall and the mean maximum and minimum temperatures. Since the weather conditions on the Nilgiris were significantly different from the plains, the data for the Nilgiris were separately tabulated and compared with the whole State pattern and the pattern at Coimbatore respectively. The results are represented graphically in Figs. 1, 2 and 3. A comparison of Figs. 1 and 2 would indicate that the patterns of seasonal occurrence of rust fungi at Coimbatore



FIGS. 1-3

and in Madras State as a whole are substantially similar. The rust collections gradually increased from July and reached a peak around December and January; very few collections have been made from March to July. It may be seen that the occurrence of rust fungi closely follows the rainfall but reaches a peak after the rainy season is over and temperatures have reached a minimum. The seasonal distribution of telial collections is also indicated in Fig. 1. It may be seen that this follows more or less the same pattern as that of rust collections but slightly shifted to later in the season. This could be explained by the fact that telia always follow the uredia and other stages of the rust fungi.

Figure 3 indicates that the pattern of occurrence of rust fungi on the Nilgiris Mountains is different from that in the plains. Peak collections have been made in September with subsidiary peaks in January and March. The collections in October and November have been poor. The heavy rains in October and November seem to have adversely affected the occurrence of rust fungi on the Nilgiris. But when compared to the plains the rust fungi seem to be more evenly distributed throughout the year. The lower temperatures prevailing throughout the year on the Nilgiris are probably responsible for this.

An examination of the rust collections made over a period of more than fifty years showed that genera like, *Ravenelia*, *Scopella*, *Masseeella*, *Cerotelium*, and *Trochodium* were entirely tropical being confined to the plains of Madras State while the genera *Puccinia*, *Uromyces*. *Hemileia*, *Kuehneola* and *Hapalophragmium* had a wider distribution, species of these genera being found on the temperate mountains and on the plains. The genera *Phragmidium*, *Phragmotelium*, *Gambleola* and *Hamaspora* were confined to the temperate mountains.

The data presented in this note formed part of the Doctoral thesis of the senior author. The authors are grateful to the University of Madras for granting permission to publish this paper and to the Indian Council of Agricultural Research for award of a Fellowship to the senior author enabling this study.

Division of Plant Pathology,
Agricultural College and Research Institute,
Coimbatore-3, April 13, 1970.
A. N. RAGHUNATHAN.*
K. RAMAKRISHNAN.

---

* Present address: Infestation Control Division, Central Food Technological Research Institute, Mysore.

A NEW REPORT ON THE PREDATORY HABIT OF THE BEETLES *ALPHETOBIUS PICEUS* (OLIV.) AND *TRIBOLIUM CASTANEUM* (HUB.) ON *ARGAS PERSICUS* (OKEN, 1818)

DURING the month of May and June 1969, while collecting the fowl tick *Argas persicus* in various poultry farms of Bikaner, Jaipur and Jodhpur in Rajasthan an interesting predatory relationship was observed which has not been reported so far between the fowl tick and the two above-named beetles. These beetles are known, so far, only as minor pests of stored grains.

The ticks collected were kept in wooden cages without food and left as such uncared for a month. Later, it was found that all the ticks had disappeared and the larvæ and adults of the two beetles named above were the only flourishing denizens of the cage. The half eaten bodies of the acarinids indicated that they had been eaten by the beetles.

In order to test the predaceous propensities of the beetles, an individual tick (*A. persicus*) with an individual beetle (*A. piceus*) was segregated and the tick was all but gone in a 24-hour period, leaving a ring like outermost body part, the legs and the mouthparts. In another cage one beetle was kept with several ticks and within 24 hours the beetle had eaten two ticks, but incompletely.

A. piceus is black in colour and is almost of the same size as the tick, which moves very slowly. The beetle starts nibbling the tick from behind or from the sides. The tick does not react while it is being devoured in this manner. The victim, because of absence of eyes and perhaps deficiency of sense organs on the body, makes no resistance while it is being consumed steadily by the beetle.

T. castaneum is brown and much smaller in size than the tick. It nibbles very slowly and the tick dies in a couple of days and soon dries into a crust, at which stage the beetle leaves it.

Besides the adult, the larvæ of both the beetles also devour the tick, the only difference being that the latter devour the dead bodies left by the former but do not attack the live tick. An interesting aspect of the food chain is noteworthy (Fig. 1). It has been reported that a reduviid bug *Amphebolous venator* is a predator on the larvæ of a number of insects of various orders, among which the coleopterans are *Alphetobius piceus*, *A. diaperinus* and *Tribolium castaneum*.[1,2]

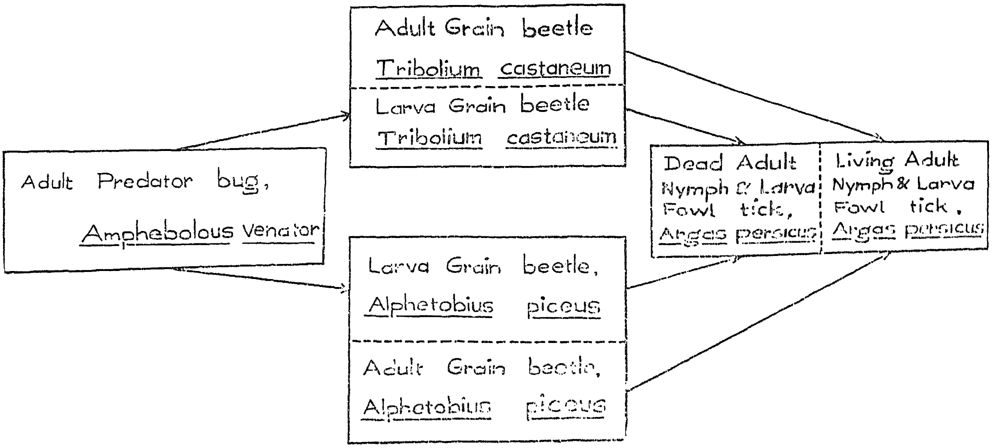


FIG. 1. Food chain relationship of the Fowl tick, the two Grain beetles and the Predator bug.

Thanks are due to Dr. S. D. Misra, Professor and Head of Zoology Department for the guidance and critically going through the manuscript, and to Dr. K. S. Pradhan and Dr. T. G. Vazirani of Z.S.I., Calcutta, for the identification of the beetles.

Dept. of Zoology, AZAD KUMAR PUROHIT.
Univ. of Jodhpur,
Jodhpur, Rajasthan, *April* 4, 1970.

---

1. Pingle, S. V., *Proc. Ind. Sci. Cong. Abs. 40th Sess.*, 1953, p. 197.
2. —, *Ind. J. Ent.*, 1954, **16**, 300.

EFFECT OF MIXTURE OF INOCULATIONS OF VIRULENT AND LESS VIRULENT ISOLATES OF *XANTHOMONAS ORYZAE*

IN view of the differences in pathogenicity noticed amongst the isolates of *Xanthomonas oryzœ* (Devadath and Padmanabhan[3]), it was of interest to know whether the use of mixture of inoculum would be representative of the range of virulence and pathogenicity exhibited by the individual isolates of a mixture. Therefore, investigation was carried out with a mixture of inoculum of two isolates, one virulent and another less virulent.

Seedlings of *Taichung* (*Native*) 1, a highly susceptible variety, were used as test plants. Seedlings were grown in steam-sterilized soil in 4-in. earthen pots and were supplied with 80 N.

Two isolates, one very virulent isolate E and the other less virulent isolate F, were used. Twenty-four hours shaker incubated cultures in NY broth (nutrient broth + 0·5% yeast extract) were centrifuged. The cells were washed thrice by centrifugation. Finally, the optical density of each isolate was adjusted to 0·5. The bacterial suspensions thus prepared were mixed in proportions ranging from 100% E : 0% F through 75% E : 25% F, 50% E : 50% F, 25% E : 75% F to 0% E : 100% F and used for inoculation.

When the plants were 5–6 leaf stage the first leaf of each test plant from the top leaving the youngest unfolding leaf was inoculated by the side of the main vein at one-third of the upper part of each leaf-blade by multiple pin-prick method. There were ten plants under each treatment.

The inoculation was carried out twice, the first on September 10, and the second on September 25 of 1968 on two different sets of plants.

The length of the lesion was measured after 10 days from the point of inoculation upto its greatest spread below the point.

The average length of lesion per leaf in each treatment is presented in Table I.

TABLE I

The influence of mixed inoculum in the lesion length produced by virulent and less virulent isolates of X. oryzæ

Per cent. of mixture of virulent (E) and less virulent (F) cells	Average length of lesion per leaf	
	Expt. 1	Expt. 2
E : F	..	..
100 : 0	8·41	8·74
75 : 25	6·22	6·48
50 : 50	4·52	4·45
25 : 75	3·27	3·71
0 : 100	3·09	3·32
CD (5%) =	0·77	0·46

It might be seen from Table I that the reaction of the host was influenced by mixing the inocula of virulent and less virulent isolates. The virulent isolate E produced the longest lesion while the less virulent isolate F produced the shortest lesion. The lesion length was significantly reduced in direct proportion to the ratio of virulent and less virulent cells in the inoculum. There was no significant difference in lesion length between 25 : 75 and 0 : 100 proportion of mixing virulent to less virulent cells.

Similar results have been reported with inoculation of mixture of isolates of *Pseudomonas solanacearum* by Averre III and Kelman,[1] and Buddenhagen.[2]

It is clear from this study that the disease intensity can be influenced to a great extent by mixing the isolates possessing different degrees of virulence. Therefore, the most virulent isolate occurring in a region has to be used in breeding for disease resistance.

I express my deep sense of gratitude to Dr. S. Y. Padmanabhan, Director, for his keen interest and encouragement in carrying out this investigation.

Division of Mycology, S. DEVADATH.
Central Rice Res. Inst.,
Cuttack-6 (Orissa), *April* 21, 1970.

---

1. Averre III, C. W. and Kelman, A., *Phytopathology*, 1960, **50**, 627 (Abstr.).
2. Buddenhagen, I. W., *Symposium on Plant Diseases in the Pacific—XI Pacific Science Congress*, Tokyo, 1966, 1-14.
3. Devadath, S. and Padmanabhan, S. Y., *Pl. Dis. Reptr.*, 1969, **53** (2), 145-148.

STUDIES ON DARKENING OF WHOLE WHEAT MEAL DOUGH

IN India, most of the wheat is consumed in the form of *Chapatties*, a kind of un-leavened pan-baked bread. For this purpose, wheat grains are ground to a whole wheat meal. Until recently, a number of varieties were available in this country which were acceptable to the consumer for *Chapati*-making. This acceptability is based on amber-coloured grains, creamish flour, sweetness, palatability and good puffing characteristics of *Chapatties*.[1]

Recent introduction of Mexican germ plasm under *High Yielding Varieties Programme*[2] has resulted in the availability to the consumer of wheat grains of inferior quality from the view-point of *Chapati*-making. Studies have been initiated in this laboratory to investigate the causative factors which lead to the browning of the whole wheat meal dough, commonly referred to as *'atta'*, early onset of fermentation, gluten characteristics which lead to leatheriness of *Chapatties* on storage. In this communication, biochemical factors responsible for darkening of whole wheat meal dough of Mexican varieties are reported.

Experiments were conducted with three Mexican varieties, *viz.*, Lerma rojo, Sonora' 64 and Sonalika and three Indian varieties, *viz.*, Pb. C 273, Pb. C 591 and Pb. C. 281. The grains were ground in Labconco Mill to pass through 40 mesh. Various milling fractions were obtained by using a micro-mill following Seaborg and Barmore's method.[3] Preliminary findings showed that whole wheat meal dough of Mexican varieties turns brown and subsequently dark in colour within a period of 6–8 hours when kept at 30–32° C. while the dough of Indian varieties remains creamish, *viz.*, retains its original colour (*see* Fig. 1).

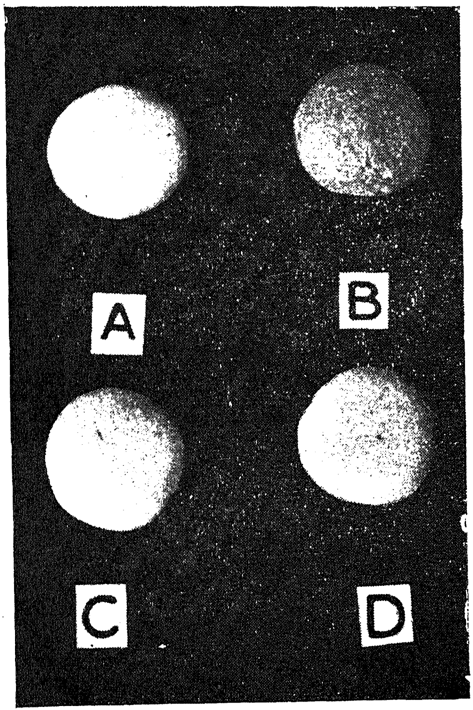


FIG. 1. Whole meal dough colour. Mexican wheat variety, *viz.*, Sonalika. A—At 0 hour. B—After 8 hours keeping at 32 ± 2° C. Indian wheat variety, *viz.*, Pb. C 281. C—At 0 hour. D—After 8 hours keeping at 32 ± 2° C.

To elucidate the nature of the browning reaction, wheat grains of Mexican varieties, prior to preparation of whole meal were soaked in distilled water for two hours, immersed in boiling water for thirty minutes and then dried in an oven at 100° C. It was observed that this treatment results in cessation of browning, suggesting thereby that certain enzymatic reactions are responsible for this characteristic.

Tyrosinase activity and subsequent polymerisation of quinones to melanin is known to be responsible for the browning of various biological materials.[4,5] To study the role of tyrosinase, doughs of Mexican varieties were prepared in 0·1% sodium diethyl dithiocarbamate which acts as a chelating agent for copper. Observations after 6–8 hours showed that doughs retain their original colour. This suggests the possible involvement of tyrosinase activity in darkening reaction.

Addition of various substrates, *viz.*, L-tyrosine, phenol, catechol and DL-dihydroxy phenylalanine results in darkening of the doughs of Mexican varieties within 30 minutes while the dough of Indian varieties remained creamish in colour.

For assay of tyrosinase activity, colorimetric method of Horowitz *et al.*[6] was followed using DL-dihydroxy phenylalanine as substrate. Increase in O.D. per mg. protein is given in Table I. Tyrosinase activity is high in the Mexican varieties as compared to that of Indian wheats studied. Subsequently, tyrosinase activity was determined in the various milling fractions so as to locate the enzyme. The study shows that major amount of the enzyme activity is detectable in the bran. The other two fractions, *viz.*, shorts and white flour show little or no activity (Table I).

TABLE I

Tyrosinase activity (Change in O.D./mg. protein) in whole meal and various milling fractions of Mexican and Indian wheat varieties. DL-DOPA *was used as a substrate*[6]

Varieties	Tyrosinase activity			
	Whole meal	Bran	Shorts	White flour
Lerma rojo ..	0·10	0·35	0·02	0·00
Sonalika ..	0·10	0·40	0·01	0·02
Sonora'64 ..	0·12	0·36	0·01	0·01
Pb. C 273 ..	0·02	0·12	0·01	0·02
Pb. C 281 ..	0·03	0·13	0·00	0·02
Pb. C 591 ..	0·02	0·16	0·01	0·00

From the above findings one can conclude that tyrosinase activity and subsequent formation of melanin are responsible for the darkening of the whole wheat meal dough of Mexican varieties.

The authors wish to thank Dr. H. K. Jain, Head of the Division of Genetics, for suggesting the problem and providing the facilities.

Division of Genetics, Y. P. ABROL.
Indian Agri. Research Ins., D. C. UPRETY.
New Delhi-12, *March* 2, 1970.

---

1. Austin, A., *Jour. P.G. School*, 1966, **4**, 54.
2. Anonymous, *Five Years of Research in Dwarf Wheats*, Indian Agricultural Research Institute, New Delhi-12, 1968.
3. Seaborg, E. F. and Barmore, M. A., *Cereal Chemistry*, 1957, **34**, 299.
4. Franke, W., "Phenoloxydasen und Ascorbicsaure-oxydase," *Handbuch der Pflanzen-physiologie*, 1960, **12** (1), 401.
5. Malmström, G. and Ryden, L., In *Biological Oxidations*, Edited by Thomas, P. Singer, Interscience Publishers, John Wiley & Sons, New York, 1968.
6. Horowitz, N. H., Fling, M., Macleod, H. L. and Sueoka, N., *Jour. Mol. Biol.*, 1960, **2**, 96.

A NEW SPECIES OF *CLADOSPORIUM* FROM THE SAND DUNES OF WESTERN RAJASTHAN, INDIA

THE rhizosphere microflora of ten different plants which were found all the year round on the sand dunes of Masuria, Jodhpur, was studied. The rhizosphere fungal flora associated with the plants was determined at regular intervals of one month. The fungi were isolated by the soil dilution and plate count method.[11] During these studies colonies of *Cladosporium* were isolated from the rhizosphere region of *Acacia nilotica* (Linn.) Del. sub. sps. *indica* (Benth.) Brenan. The conidial morphology of the isolate was compared with all the known species of *Cladosporium*. The culture was sent to C.M.I., Kew, where it was examined by Dr. Ellis, but it could not be assigned to any specific position. Dr. Ellis wrote "This *Cladosporium* is quite new to our herbarium and may well be an undescribed species".

The present isolate shows a pronounced difference from all other species of *Cladosporium* in its conidial morphology. The conidia of the present isolate are usually three- to four-celled, rarely they are one-to two-celled. The size and shape of the conidia are also quite different from all the known species of the genus (Saccardo,[9] Dale,[6] Waksman,[12] Abbot,[1] Bisby *et al.*,[3] Chaudhuri,[5] Galloway,[8] Subramanian[10] and Arya and Panwar[2]). The isolate is, therefore, being designated as *Cladosporium acaciæ* sp. nov.

Cladosporium acaciæ SP. NOV.

Colonies black-green, growth fluffy; hyphæ hyaline or light-brown, profusely branched, septate, 3 to 13 μ wide, chlamydospores frequently formed; conidiophores erect, light-brown, septate, 16 to 47 μ long; conidia 1–4-celled, pale-yellow to light-brown, ovoid to elliptical with constrictions at the point of septation, borne terminally or laterally in chains; conidia one-celled 11 × 4 μ; conidia 2-celled 15 × 5 μ; conidia 3-celled 17 × 6 μ; conidia 4-celled 23 × 7 μ (Figs. 1 and 2).

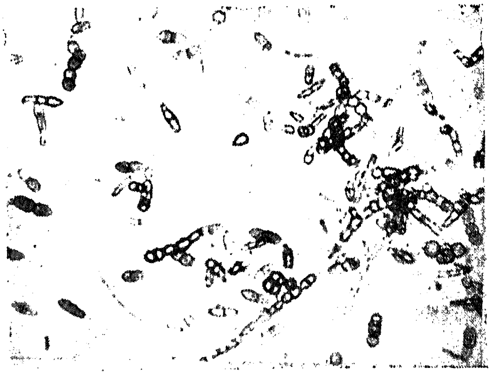


FIG. 1. Photomicrograph showing conidia, × 300.

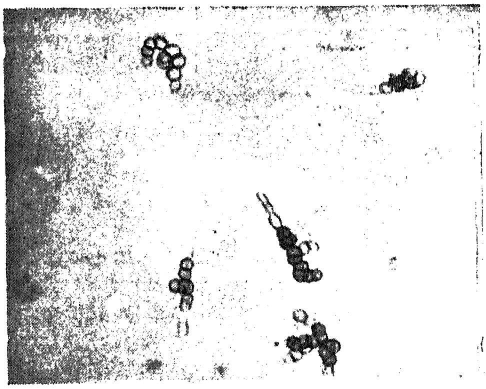


FIG. 2. Photomicrograph showing chlamydospores, × 300.

Culture deposited in C.M.I., Kew. Culture No. IMI 104172. Collected from rhizosphere region of *Acacia nilotica* (Linn.) Del. sub. sps. *indica* (Benth.) Brenan. Coll.: K.S., J.M.L. No. 16.

Cladosporium acaciæ SP. NOV.

Coloniæ atro-virides, floccosæ, hyphæ hyalinæ vel pallide brunneæ frequenter ramosæ septatæ, 3–13 μ crassæ, chlamydosporas crebras efformantes; conidiophoræ erectæ, pallide brunneæ, septatæ, 16–47 μ longæ; conidia 1–4-cellularia, pallide lutea vel pallide brunnea, ovoidea vel elliptica, ad septas constricta, ex apice vel latere conidiopholurum orta, unicellularia 11 × 4 μ, bicellularia 15 × 5 μ, tricellularia 17 × 6 μ, quadricellularia 23 × 7 μ.

Cultura apud Institutum Mycologicum Respublicæ kewensem (C.M.I.) deposita sub numero IMI 104172.

The author wishes to thank Dr. Donald P. Rogers, Professor of Botany, University of Illinois, U.S.A., for Latin diagnosis. The help received from Dr. M. B. Ellis of C.M.I., Kew, England, is gratefully acknowledged.

Department of Botany, K. S. PANWAR.
University of Jodhpur,
Jodhpur, *March* 28, 1970.

---

1. Abbott, E. V., *Iowa State Coll. Jour. Sci.*, 1926, **1**, 15.
2. Arya, H. C. and Panwar, K. S., *Indian Phytopath.*, 1955, **8**, 176.
3. Bisby, G. R., James, N. and Timonin, M., *Canadian Jour. Res.*, 1933, **8**, 253.
4. Bond, T. E. T., *Ann. Appl. Biol.*, 1938, **25**, 277.
5. Chaudhuri, H. and Sacher, G. S., *Ann. Mycol.*, 1934, **32**, 90.
6. Dale, Elizabeth, *Ibid.*, 1912, **10**, 452.
7. Dastur, J. F., *C.P. Proc. World's Grains Exhibition Conf. Regina*, 1936, **11**, 253.
8. Galloway, L. D., *Ind. Jour. Agr. Sci.*, 1936, **6**, Pt. 1, 578.
9. Saccardo, P. A., *Sylloge Fungorum*, 1888, **4**, 350.
10. Subramanian, C. V., *Jour. Madras Univ.*, 1952, **22 B**, 206.
11. Timonin, M. I., *Canadian Jour. Res.*, 1940, **18C**, 307.
12. Waksman, S. A., *Soil Sci.*, 1916, **2**, 103.

CHROMOSOME NUMBER IN OAK FEEDING TASAR SILKWORM, *ANTHERAEA ROYLEI* MOORE

THE chromosome numbers of the sericigenous members of the genus *Antherœa* have mostly been elucidated leaving behind a few indigenous species. *Antherœa roylei* Mr., the Indian Oak feeding tasar species, is one of them which produces brilliant silvery silk fibre of finer denier. A recent work has revealed that this species when crossed with its Chinese counterpart (*A. pernyi* G.M.) produced fertile hybrid (Jolly *et al.*, 1969). The chromosome number of *A. pernyi* as worked out by *Kawaguchi (1933–34 *a*) is $n = 49$. A study was, therefore, required to understand the chromosome number of *A. roylei.*

The stock of *Antherœa roylei* is being maintained at Ramsu (Jammu) at an altitude of about 5,000 feet. Testes of male larvæ, 8th day after the fourth moult, were fixed in 1 : 3

acetic-alcohol for 4 hr. and then preserved in 70% alcohol. Temporary squashes were prepared in aceto-carmine with a trace of ferric chloride after a temperature treatment of 50° C. for 60 minutes. Chromosomes were counted at a magnification of 100 × 16 X.

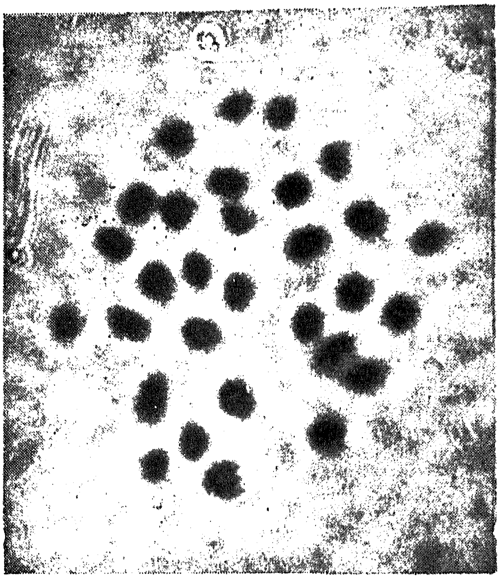


FIG. 1

Polar view of meiotic metaphases (Fig. 1) has shown 30 distinct bivalents, oval in shape with little variation in their size. Chromosomes are not usually equidistant. The results have been verified in numerous subsequent preparations.

The study has revealed n = 30 chromosomes in *A. roylei* Mr. The results of the hybrids between *Antheraea pernyi* (n = 49) and *yamamai* G.M. (n = 31, Kawaguchi, 1933-34 *b*, Kawaguchi, 1933-34 *c*) and the results in the crosses between *A. roylei* (n = 30, finding of the present authors) and *pernyi* (Jolly *et al.*, 1969) have opened a passage for the cytogeneticists to think about the chromosome compatibility.

Central Tasar Research
Station,
Ranchi, *March* 24, 1970.

M. S. JOLLY.
S. K. SEN.
S. S. SINHA.

---

* All the references of Kawaguchi have been quoted by Makino (1956).

1. Jolly, M. S., Narasimhanna, M. N., Sinha, S. S. and Sen, S. K., *Ind. J. Ser. Research*, 1969, **1** (1), 45.
2. Makino, S., *A Review of Chromosome Number in Animals*, Hokuryukan, Tokyo, 1956, p. 110.

REVIEWS AND NOTICES OF BOOKS

Catalysis Reviews (Vol. 3). Edited by Heinz Heinemann. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. vii + 281. Price $17.50; £8 7*sh.* 0*d.*

Although research in recent years has greatly advanced, our knowledge of catalysis, the ultimate goal of predicting catalytic behaviour has not been reached. *Catalysis Reviews* is designed to stimulate new thought and approaches to this broad science. Coverage emphasizes the interdisciplinary aspects of catalysis. Compartmentalization is avoided and phenomena and observations at the periphery as well as the center of the field are critically examined. Advances in technology as well as theory, both engineering and chemical aspects of catalytic reactions, reactor design, computer models, analytical tools, and statistical evaluations, to name only a few subjects, are reviewed. The chapters are not limited only to homogeneous and heterogeneous catalysis, they concern as well solid-state physics and chemistry, electrochemistry, metallurgy, corrosion, polymerization, biochemistry, and other fields which add to knowledge of catalytic phenomena by analogy or deduction.

The titles of the chapters contained in Volume 3 are: Electrochemical Methods for Investigating Catalysis by Semiconductors, by T. Freund and W. P. Gomes; Olefin Disproportionation, by G. C. Bailey; Heat and Mass Diffusional Intrusions in Catalytic Reactor Behaviour, by James J. Carberry; The Chemical Adsorption of Sulfur on Metals: Thermodynamics and Structure, by J. Benard; Fixation of Molecular Nitrogen, by K. Kuchynka; Olefin Polymerization on Supported Chromium Oxide Catalysts, by Alfred Clark; Catalytic Hydrogenolysis Over Supported Metals, by J. H. Sinfelt; Chemical Relaxation of Surface

Reactions, by G. Parravano; and Identification of Rate Models for Solid Catalyzed Gaseous Reactions, by Reiji Mezaki and John Happel.

This book, published from the journal edition to make available a durable, hard-bound, fully indexed publication, provides a broad coverage of the field. Chemists, solid-state physicists, metallurgists, engineers, other scientists in the chemical process industry, and professors of chemistry and related fields will benefit from the material presented. C. V. R.

Spectral Analysis (*Methods and Techniques*). Edited by James A. Blackburn. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xi + 289. Price $ 15.75; £ 10 10 *sh*.

Significant advances in computer technology during the past few years have made exhaustive analysis of many forms of data routinely possible. In particular, digital computing techniques are now being turned to the problems associated with analyzing discretely sampled records or spectra. Widespread interest in these methods has indicated the need for a broad sampling of current activity in the field of spectrum analysis.

Topics covered in this book include: Concepts from Information Theory, Digital Filtering, Spectrum Decomposition, Statistical Weighting Functions, Signal to Noise Enhancement, the Simplex Method, and the Use of Certain Generalized Functions. Applications in Biology, Neutron Activation Analysis, Mass Spectrometry and Gamma Spectrum Analysis are discussed.

The balance between mathematical methods and problem oriented illustrations has been intentionally varied throughout the book. The first four chapters elucidate some of the major mathematical techniques, while the concluding chapters illustrate many of these concepts through specific applications.

This book is not aimed at an audience which might be categorized by discipline (physicist, chemist, etc.); rather, it is directed at scientists faced with the problem of reducing and interpreting spectral data. The material in this volume is relevant to such diverse fields as: acoustics, Fourier spectroscopy, power spectrum analysis, telemetry and communications, nuclear physics, microwaves, neutron activation analysis, and chromatography. C. V. R.

Annual Review of Pharmacology (Vol. 10). Edited by H. W. Elliott. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1970. Pp. vii + 505. Price U.S.A. $ 8.50; other countries: $ 9.00.

Volume 10 of this well-known series, *Annual Review of Pharmacology*, contains the following chapters: Pharmacology and Medicine, by Hiroshi Kumagai; Receptor Mechanisms, by A. S. V. Burgen; Cyclic AMP and Drug Action, by Bruce McL. Breckenridge; Specific Irreversible Enzyme Inhibitors, by B. R. Baker; Relationships Between Stereostructure and Pharmacological Activities, by Philip S. Portoghese; The Metabolic Alteration of Drugs, by Eric C. Schreiber; Species Differences in Drug Metabolism, by Hopard B. Hucker; Antibiotic Interaction with Model Membranes, by Stephen C. Kinsky; Pharmacology of Viruses, by Barry Goz and William H. Prusoff; Non-steroid Anti-Inflammatory Agents, by Murray Weiner and Sam J. Piliero; Inhibitors of Adrenal Steroid Biosynthesis, by T. Eugene Temple and Grant W. Liddle; Endocrine Hormones, by Patrick A. Diassi and Zola P. Horovitz; Antifertility Agents, by C. W. Emmens; Developmental Pharmacology, by Bernard L. Mirkin; Regulation of Norepinephrine Biosynthesis, by Norman Weiner; Cardiac Pharmacology, by Rafael Mendez and Emilo Kabela; Psychopharmacology, by Harold E. Himwich and Hilma S. Alpers; Cellular Aspects of Invertebrate Neuropharmacology, by D. A. Sakharov; Persistent Pesticides, by J. Robinson; Toxicity of Ozone, Oxygen, and Radiation, by Daniel B. Menzel; Aerospace Problems in Pharmacolog and Toxicology, by Kenneth C. Back and Ar thony A. Thomas; Challenges in Drug Evaluation in Man, by Louis Lasagna; L-Asparaginase and L-Asparagine Metabolism, by D. A. Cooney and R. E. Handschumacher; and Review of Reviews, by Chauncey D. Leake. C. V. R.

Vinyl Polymerization (Vol. 1, Part II). Edited by G. E. Ham. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 416. Price $ 22.50 or £ 10 14 *sh*.

Despite the number of books being published in the polymer field, one of the vital needs is a series of volumes devoted to the area of kinetics and mechanisms of polymerization.

This is the first volume in this area of a three-volume treatise intended to encompass the wide field of polymerization. In two parts, it treats polymerization of vinyl compounds,

acetic-alcohol for 4 hr. and then preserved in 70% alcohol. Temporary squashes were prepared in aceto-carmine with a trace of ferric chloride after a temperature treatment of 50° C. for 60 minutes. Chromosomes were counted at a magnification of 100 × 16 X.

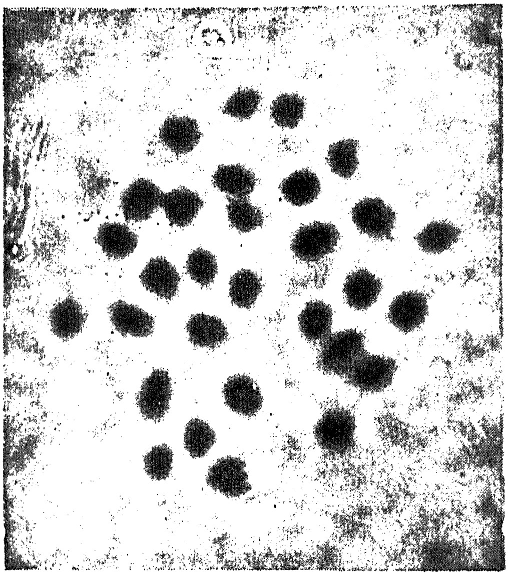


FIG. 1

Polar view of meiotic metaphases (Fig. 1) has shown 30 distinct bivalents, oval in shape with little variation in their size. Chromosomes are not usually equidistant. The results have been verified in numerous subsequent preparations.

The study has revealed $n = 30$ chromosomes in *A. roylei* Mr. The sterility of the hybrids between *Antheraea pernyi* ($n = 49$) and *yamamai* G.M. ($n = 31$, Kawaguchi, 1933-34 *b*, Kawaguchi, 1933-34 *c*) and the fertility in the crosses between *A. roylei* ($n = 30$; finding of the present authors) and *pernyi* (Jolly *et al.*, 1969) have opened a passage for the cytogeneticists to think about the chromosome compatibility.

Central Tasar Research
Station,
Ranchi, *March* 24, 1970.

M. S. JOLLY.
S. K. SEN.
S. S. SINHA.

---

* All the references of Kawaguchi have been quoted by Makino (1956).

1. Jolly, M. S., Narasimhanna, M. N., Sinha, S. S. and Sen, S. K., *Ind. Jour. Heredity*, 1969, **1** (1), 45.
2. Makino, S., *A Review of Chromosome Number in Animals*, Hokuryukan, Tokyo, 1956, p. 110.

REVIEWS AND NOTICES OF BOOKS

Catalysis Reviews (Vol. 3). Edited by Heinz Heinemann. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. vii + 281. Price $ 17.50 ; £ 8 7 *sh.* 0 *d.*

Although research in recent years has greatly advanced, our knowledge of catalysis, the ultimate goal of predicting catalytic behaviour has not been reached. *Catalysis Reviews* is designed to stimulate new thought and approaches to this broad science. Coverage emphasizes the interdisciplinary aspects of catalysis. Compartmentalization is avoided and phenomena and observations at the periphery as well as the center of the field are critically examined. Advances in technology as well as theory, both engineering and chemical aspects of catalytic reactions, reactor design, computer models, analytical tools, and statistical evaluations, to name only a few subjects, are reviewed. The chapters are not limited only to homogeneous and heterogeneous catalysis; they concern as well solid-state physics and chemistry, electrochemistry, metallurgy, corrosion, polymerization, biochemistry, and other fields which add to knowledge of catalytic phenomena by analogy or deduction.

The titles of the chapters contained in Volume 3 are: Electrochemical Methods for Investigating Catalysis by Semiconductors, by T. Freund and W. P. Gomes; Olefin Disproportionation, by G. C. Bailey; Heat and Mass Diffusional Intrusions in Catalytic Reactor Behaviour, by James J. Carberry; The Chemical Adsorption of Sulfur on Metals: Thermodynamics and Structure, by J. Benard; Fixation of Molecular Nitrogen, by K. Kuchynka; Olefin Polymerization on Supported Chromium Oxide Catalysts, by Alfred Clark; Catalytic Hydrogenolysis Over Supported Metals, by J. H. Sinfelt; Chemical Relaxation of Surface

Reactions, by G. Parravano; and Identification of Rate Models for Solid Catalyzed Gaseous Reactions, by Reza Mezaki and John Happel.

The book is published from the journal edition to make available a durable, hard-bound, fully indexed publication, provides a broad coverage of the field. Chemists, solid-state physicists, metallurgists, engineers, other scientists in the chemical process industry, and professors of chemistry and related fields will benefit from the material presented. C. V. R.

Spectral Analysis (*Methods and Techniques*). Edited by James A. Blackburn. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xi + 289. Price $ 15.75 ; £ 10 10 *sh*.

Significant advances in computer technology during the past few years have made exhaustive analysis of many forms of data routinely possible. In particular, digital computing techniques are now being turned to the problems associated with analyzing discretely sampled records or spectra. Widespread interest in these methods has indicated the need for a broad sampling of current activity in the field of spectrum analysis.

Topics covered in this book include: Concepts from Information Theory, Digital Filtering, Spectrum Deconvolution, Statistical Weighting Functions, Signal to Noise Enhancement, the Simplex Method, and the Use of Certain Generalized Functions. Applications in Biology, Neutron Activation Analysis, Mass Spectrometry and Gamma Spectrum Analysis are discussed.

The balance between mathematical method and problem oriented illustrations has been intentionally varied throughout the book. The first four chapters elucidate some of the major mathematical techniques, while the concluding chapters illustrate many of these concepts through specific applications.

The book is not aimed at an audience which might be categorized by discipline (physicist, chemist, etc.); rather, it is directed at scientists faced with the problem of reducing and interpreting spectral data. The material in this volume is relevant to such diverse fields as: acoustics, Fourier spectroscopy, power spectrum analysis, telemetry and communications, nuclear physics, microwaves, neutron activation analysis, and chromatography. C. V. R.

Annual Review of Pharmacology (Vol. 10). Edited by H. W. Elliott. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1970. Pp. vii + 505. Price U.S.A. $ 8.50 ; other countries : $ 9.00.

Volume 10 of this well-known series, *Annual Review of Pharmacology*, contains the following chapters: Pharmacology and Medicine, by Hiroshi Kumagai; Receptor Mechanisms, by A. S. V. Burgen; Cyclic AMP and Drug Action, by Bruce McL. Breckenridge; Specific Irreversible Enzyme Inhibitors, by B. R. Baker; Relationships Between Stereostructure and Pharmacological Activities, by Philip S. Portoghese; The Metabolic Alteration of Drugs, by Eric C. Schreiber; Species Differences in Drug Metabolism, by Hopard B. Hucker; Antibiotic Interaction with Model Membranes, by Stephen C. Kinsky; Pharmacology of Viruses, by Barry Goz and William H. Prusoff; Non-steroid Anti-Inflammatory Agents, by Murray Weiner and Sam J. Piliero; Inhibitors of Adrenal Steroid Biosynthesis, by T. Eugene Temple and Grant W. Liddle; Endocrine Hormones, by Patrick A. Diassi and Zola P. Horovitz; Antifertility Agents, by C. W. Emmens; Developmental Pharmacology, by Bernard L. Mirkin; Regulation of Norepinephrine Biosynthesis, by Norman Weiner; Cardiac Pharmacology, by Rafael Mendez and Emilo Kabela; Psychopharmacology, by Harold E. Himwich and Hilma S. Alpers; Cellular Aspects of Invertebrate Neuropharmacology, by D. A. Sakharov; Persistent Pesticides, by J. Robinson; Toxicity of Ozone, Oxygen, and Radiation, by Daniel B. Menzel; Aerospace Problems in Pharmacology and Toxicology, by Kenneth C. Back and Anthony A. Thomas; Challenges in Drug Evaluation in Man, by Louis Lasagna; L-Asparaginase and L-Asparagine Metabolism, by D. A. Cooney and R. E. Handschumacher; and Review of Reviews, by Chauncey D. Leake. C. V. R.

Vinyl Polymerization (Vol. 1, Part II). Edited by G. E. Ham. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 416. Price $ 22.50 or £ 10 14 *sh*.

Despite the number of books being published in the polymer field, one of the vital needs is a series of volumes devoted to the area of kinetics and mechanisms of polymerization.

This is the first volume in this area of a three-volume treatise intended to encompass the wide field of polymerization. In two parts, it treats polymerization of vinyl compounds,

acetic-alcohol for 4 hr. and then preserved in 70% alcohol. Temporary squashes were prepared in aceto-carmine with a trace of ferric chloride after a temperature treatment of 50° C. for 60 minutes. Chromosomes were counted at a magnification of 100 × 16 X.

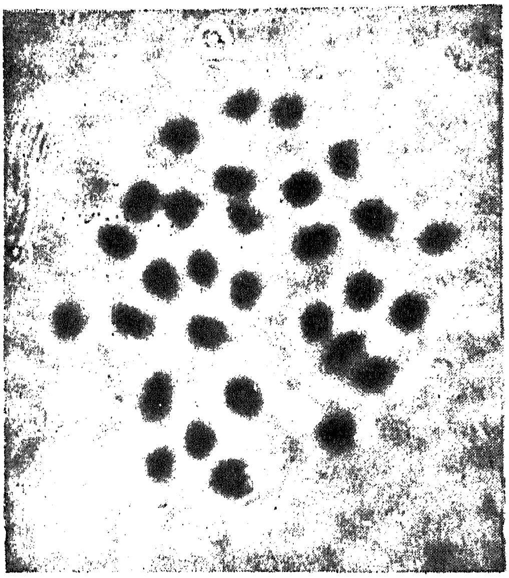


FIG. 1

Polar view of meiotic metaphases (Fig. 1) has shown 30 distinct bivalents, oval in shape with little variation in their size. Chromosomes are not usually equidistant. The results have been verified in numerous subsequent preparations.

The study has revealed $n = 30$ chromosomes in *A. roylei* Mr. The fertility of the hybrids between *Antheraea pernyi* ($n = 49$) and *yamamai* G.M. ($n = 31$, Kawaguchi, 1933–34 *b*, Kawaguchi, 1933–34 *c*) and the fertility in the crosses between *A. roylei* ($n = 30$; finding of the present authors) and *pernyi* (Jolly *et al.*, 1969) have opened a passage for the cytogeneticists to think about the chromosome compatibility.

Central Tasar Research
Station,
Ranchi, *March* 24, 1970.

M. S. JOLLY.
S. K. SEN.
S. S. SINHA.

---

* All the references of Kawaguchi have been quoted by Makino (1956).

1. Jolly, M. S., Narasimhanna, M. N., Sinha, S. S. and Sen, S. K., *Ind. Jour. Heredity*, 1960, **1** (1), 45.
2. Makino, S., *A Review of Chromosome Number in Animals*, Hokuryukan, Tokyo, 1956, p. 110.

REVIEWS AND NOTICES OF BOOKS

Catalysis Reviews (Vol. 3). Edited by Heinz Heinemann. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. vii + 281. Price $ 17.50 ; £ 8 7 *sh.* 0 *d.*

Although research in recent years has greatly advanced, our knowledge of catalysis, the ultimate goal of predicting catalytic behaviour has not been reached. *Catalysis Reviews* is designed to stimulate new thought and approaches to this broad science. Coverage emphasizes the interdisciplinary aspects of catalysis. Compartmentalization is avoided and phenomena and observations at the periphery as well as the center of the field are critically examined. Advances in technology as well as theory, both engineering and chemical aspects of catalytic reactions, reactor design, computer models, analytical tools, and statistical evaluations, to name only a few subjects, are reviewed. The chapters are not limited only to homogeneous and heterogeneous catalysis; they concern as well solid-state physics and chemistry, electrochemistry, metallurgy, corrosion, polymerization, biochemistry, and other fields which add to knowledge of catalytic phenomena by analogy or deduction.

The titles of the chapters contained in Volume 3 are: Electrochemical Methods for Investigating Catalysis by Semiconductors, by T. Freund and W. P. Gomes; Olefin Disproportionation, by G. C. Bailey; Heat and Mass Diffusional Intrusions in Catalytic Reactor Behaviour, by James J. Carberry; The Chemical Adsorption of Sulfur on Metals: Thermodynamics and Structure, by J. Benard; Fixation of Molecular Nitrogen, by K. Kuchynka; Olefin Polymerization on Supported Chromium Oxide Catalysts, by Alfred Clark; Catalytic Hydrogenolysis Over Supported Metals, by J. H. Sinfelt; Chemical Relaxation of Surface

Reactions, by G. Parravano; and Identification of Rate Model for Solid Catalyzed Gaseous Reactions, by Reza Mezaki and John Happel.

The book, published from the journal edition to make available a durable, hard-bound, fully indexed publication, provides a broad coverage of the field. Chemists, solid-state physicists, metallurgists, engineers, other scientists in the chemical process industry, and professors of chemistry and related fields will benefit from the material presented. C. V. R.

Spectral Analysis (*Methods and Techniques*). Edited by James A. Blackburn. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xi + 289. Price $ 15.75; £ 10 10 *sh.*

Significant advances in computer technology during the past few years have made exhaustive analyses of many forms of data routinely possible. In particular, digital computing techniques are now being turned to the problems associated with analyzing discretely sampled records or spectra. Widespread interest in these methods has indicated the need for a broad sampling of current activity in the field of spectrum analysis.

Topics covered in this book include: Concepts from Information Theory, Digital Filtering, Spectrum Deconvolution, Statistical Weighting Functions, Signal to Noise Enhancement, the Simplex Method, and the Use of Certain Generalized Functions. Applications in Biology, Neutron Activation Analysis, Mass Spectrometry and Gamma Spectrum Analysis are discussed.

The balance between mathematical method and problem-oriented illustrations has been intentionally varied throughout the book. The first four chapters elucidate some of the major mathematical techniques, while the concluding chapters illustrate many of these concepts through specific applications.

The book is not aimed at an audience which might be categorized by discipline (physicist, chemist, etc.), rather, it is directed at scientists faced with the problem of reducing and interpreting spectral data. The material in this volume is relevant to such diverse fields as: acoustics, Fourier spectroscopy, power spectrum analysis, telemetry and communications, nuclear physics, microwaves, neutron activation analysis, and chromatography. C. V. R.

Annual Review of Pharmacology (Vol. 10). Edited by H. W. Elliott. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1970. Pp. vii + 505. Price U.S.A. $ 8.50; other countries: $ 9.00.

Volume 10 of this well-known series, *Annual Review of Pharmacology*, contains the following chapters: Pharmacology and Medicine, by Hiroshi Kumagai; Receptor Mechanisms, by A. S. V. Burgen; Cyclic AMP and Drug Action, by Bruce McL. Breckenridge; Specific Irreversible Enzyme Inhibitors, by B. R. Baker; Relationships Between Stereostructure and Pharmacological Activities, by Philip S. Portoghese; The Metabolic Alteration of Drugs, by Eric C. Schreiber; Species Differences in Drug Metabolism, by Hopard B. Hucker; Antibiotic Interaction with Model Membranes, by Stephen C. Kinsky; Pharmacology of Viruses, by Barry Goz and William H. Prusoff; Non-steroid Anti-Inflammatory Agents, by Murray Weiner and Sam J. Piliero; Inhibitors of Adrenal Steroid Biosynthesis, by T. Eugene Temple and Grant W. Liddle; Endocrine Hormones, by Patrick A. Diassi and Zola P. Horovitz; Antifertility Agents, by C. W. Emmens; Developmental Pharmacology, by Bernard L. Mirkin; Regulation of Norepinephrine Biosynthesis, by Norman Weiner; Cardiac Pharmacology, by Rafael Mendez and Emilo Kabela; Psychopharmacology, by Harold E. Himwich and Hilma S. Alpers; Cellular Aspects of Invertebrate Neuropharmacology, by D. A. Sakharov; Persistent Pesticides, by J. Robinson; Toxicity of Ozone, Oxygen, and Radiation, by Daniel B. Menzel; Aerospace Problems in Pharmacology and Toxicology, by Kenneth C. Back and Anthony A. Thomas; Challenges in Drug Evaluation in Man, by Louis Lasagna; L-Asparaginase and L-Asparagine Metabolism, by D. A. Cooney and R. E. Handschumacher; and Review of Reviews, by Chauncey D. Leake. C. V. R.

Vinyl Polymerization (Vol. 1, Part II). Edited by G. E. Ham. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1969. Pp. xii + 416. Price $ 22.50 or £ 10 14 *sh.*

Despite the number of books being published in the polymer field, one of the vital needs is a series of volumes devoted to the area of kinetics and mechanisms of polymerization.

This is the first volume in this area of a three-volume treatise intended to encompass the wide field of polymerization. In two parts, it treats polymerization of vinyl compounds,

Volume 2 deals with ring-opening reactions, and Volume 3 with condensation reactions.

The chapters contained in this volume under review are: 1. The Mechanism of Emulsion Polymerization, by John W. Vanderhoff; 2. Elucidation of Emulsion Polymerization Mechanism Based upon Copolymer Studies, by W. Frank Fowler, Jr.; 3. Mechanism of the Emulsion Polymerization of Ethylene, by Harry K. Stryker, Gerald J. Mantell, and Arthur F. Helin; 4. The Mechanism of Stereospecific Polymerization of Propylene, by Wayne "E" Smith; 5. Anionic Polymerization, by Maurice Morton; 6. Mechanisms of Cationic Polymerization, by Z. Zlamal; and 7. Radiation-Induced Polymerization, by Yoneho Tabata.

Both the industrial and academic polymer scientist will find these books very useful.

C. V. R.

Aspects of Allergy and Applied Immunology (Vol. II). Editors: R. Viswanathan, R. K. Sanyal, G. Bazaz Malik, S. Arora and B. D. Miglani. (Published by New Heights, M/1024, Darya Ganj, New Delhi-6), Pp. 196. Price Rs. 30.

The volume under review contains the proceedings of the Second Convention of the Indian College of Allergy and Applied Immunology, held in the V. Patel Chest Institute, Delhi University, on 21 and 22 December 1968. It includes the full text of 25 papers presented at the Convention by nearly 40 workers in this field of research and discussions which followed each paper. It also contains the Presidential Address by Prof. R. K. Sanyal, the I.C.A.I. Oration by Prof. R. Viswanathan, and a special lecture by Dr. S. C. Lahiri.

The contents represent the current state of research on allergy, applied immunology and related problems in India.

A. S. G.

Fungi of South India. By G. Rangaswami, V. S. Seshadri and K. A. Lucy Channamma. (The University of Agricultural Sciences, Hebbal, Bangalore-24), 1970. Pp. xv + 193.

This index on the fungal flora of South India is the outcome of studies undertaken by the authors under PL 480 Grant scheme through the US Department of Agriculture, Far Eastern Regional Research Office. In the present hand-book the authors have attempted to bring together all fungi recorded from South India upto the end of 1968. For the purpose the present States of Andhra, Madras, Mysore, Kerala and Pondicherry have been included. In all, 2,019 fungi representing 567 genera have been listed.

The contents are arranged under 1. List of Fungi, pp. 1 92; 2. Bibliography, pp. 93 140; 3. Host Index, pp. 141 186; and 4. List of Genera, pp. 187 193.

The hand-book will be a useful supplement to the already existing literature on the subject.

A. S. G.

Fundamentals of Agricultural Microbiology. By K. C. Mahanta. (Published by Oxford and IBH Publishing Co., 17, Park Street, Calcutta-16), 1969. Pp. vi + 416. Price Rs. 16.

Microbiological activities play an important role in agriculture, and the study of general microbiology is an essential part of the curriculum of the graduate course students of agriculture. The author who is an experienced teacher of microbiology in agricultural institutions, has presented the subject in a clear, readable and interesting manner. The coverage includes morphology, classification and metabolism of microorganisms, microbiological techniques, fermentation, soil microbiology, microbiology of water and air, dairy microbiology and microbiology of food and food products. The text is amply illustrated.

Although written essentially as a text-book for students in Agricultural Colleges, the book will appeal to workers in other disciplines who may wish to know the fundamentals of microbiology and the experimental techniques involved in its study.

A. S. G.

Books Received

Programmed Study Aid for Introductory Physics. By J. A. Taylor. Part I *Mechanics*, Pp. 177. Price 35 *sh.*; Part II *Electricity and Magnetism*. Pp. 181. Price 35 *sh.* (Addison-Wesley Pub., Co., Inc., London W. 1, England).

Logic and Proof. By M. L. Bitting. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 129. Price 26 *sh.*

Climate and Weather. By J. A. Day and G. L. Sternes. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 407. Price 100 *sh.*

Introduction to Laboratory Chemistry—General. By A. L. Williams, R. W. Richardson, H. J. Debey, L. A. Kelly and O. G. Lien. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 197. Price not given.

2247-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

THE INDIAN ACADEMY OF SCIENCES : XXXVI ANNUAL MEETING

THE Thirty-Sixth Annual Meeting of the Indian Academy of Sciences was held at the Raman Research Institute, Bangalore, from the 7th to the 12th September 1970. It may be noted that this was the first time, since the inception of the Academy in 1934, that its Annual Meeting was held at the Academy's headquarters itself.

The week long meeting, which was made purposeful, had for its daily programme (*i*) an invited lecture followed by discussions from 10 a.m. to 12 noon, (*ii*) group discussions from 2 p.m. to 5 p.m. on a major subject of current interest at which active workers on various aspects of the subject presented their problems and the results of their investigations, and (*iii*) an evening lecture from 5 30 p.m. to 6 30 p.m. About a hundred scientists including Fellows, Invitees and Delegates attended the meeting.

After the Business Meeting of the Fellows, the plenary session opened at 10 a.m. on Monday, the 7th September 1970 with a general assembly of Fellows, Invitees and Delegates at which the President in an introductory speech welcomed the gathering of scientists. This was followed by informative talks and exchange of ideas on current progress of science in various countries of the world in which a number of speakers took part. Dr. L. A. Ramdas, Emeritus Scientist at the NPL, gave a talk on the possible reclamation of alkali-ridden soils. Dr. P. R. Pisharoty (Physical Research Laboratory, Ahmedabad) recounted his impressions of a recent visit to a Meteorological Observatory in Siberia.

The Council of the Academy were *at-home* to the guests in the evening.

Sir C. V. Raman, President of the Academy and Nobel Laureate, delivered his Presidential Address on "The Origins of Floral Colours".

The invited lecture of the morning session of the second day was given by Dr. S. Chandrasekhar (University of Mysore) on "Liquid Crystals" in which he gave a survey of the latest researches on the subject including the work done by his group at the Mysore University. At his request his co-worker Mr. Madhusudan supplemented the lecture by a short talk on the structure of some organic molecules which exhibit liquid crystal characteristics.

The subject for the group discussions for the afternoon session was "The Brain and its Functions". Dr. R. M. Varma (Director, All-India Institute of Mental Health, Bangalore) took the Chair. Six speakers dealt with different aspects of the subject, each a specialist in his field of study. Dr. Sharma (St. John's Medical College, Bangalore) spoke on "Neurophysiology", Dr. B. K. Bachhawat (Medical Hospital, Vellore) on "Neurochemistry, Dr. M. Sirsi (Indian Institute of Science, Bangalore) on "Neuropharmacology", Dr. S. Kalyanaraman (Government General Hospital, Madras) on "Neurosurgery", Dr. K. S. Mani (All-India Institute of Mental Health, Bangalore) on "Neuromedicine", and Dr. R. L. Kapur (All-India Institute of Mental Health) on "Psychiatry".

The evening lecture on the second day under the Chairmanship of Dr. R. Ananthakrishnan (Director, Institute of Tropical Meteorology, Poona) was delivered by Dr. M. K. Vainu Bappu (Director, Kodaikanal Solar Observatory) on "Solar Eclipses" in which the lecturer made special references to coronal studies and the observations of the solar eclipse of March 7, 1970 by the Indian team which he led to Mexico.

The morning lecture on the third day was by Dr. R Ramanna (Director, Physics Group, BARC, Bombay) on "Atomic Nuclei" in which he discussed a new mathematical approach to the problem of binding energy in atomic nuclei.

The group discussions on "Earthquakes" in the afternoon were held under the Chairmanship of Dr. K. R Ramanathan (Director, Physical Research Laboratory, Ahmedabad) who in his introductory speech traced the history and current status of "Seismology in India". Dr. B. P. Radhakrishna (Director, Department of Mines and Geology, Bangalore) spoke on "Indian Geology with reference to Seismology" in which he advanced arguments to show that the Deccan Plateau is not to be regarded as a seismologically quiescent zone. Mr. M. B. Ramachandra Rao (Former Member, Oil and Natural Gas Commission, India) spoke about some significant findings met with during the drilling-for-oil operations in India, which had special reference to the theory of isostasy. Dr. Kaila (NGI, Hyderabad) gave a detailed account of the work being done at the National Geophysical Institute in his talk on "Seismological Studies at Hyderabad". Mr. T. G. Varghese in his talk on "Earthquake Data from Gauribidanur" gave an account of the working

Volume 2 deals with ring-opening reactions, and Volume 3 with condensation reactions.

The chapters contained in this volume under review are: 1. The Mechanism of Emulsion Polymerization, by John W. Vanderhoff; 2. Elucidation of Emulsion Polymerization Mechanism Based upon Copolymer Studies, by W. Frank Fowler, Jr.; 3. Mechanism of the Emulsion Polymerization of Ethylene, by Harry K. Stryker, Gerald J. Mantell, and Arthur F. Helin; 4. The Mechanism of Stereospecific Polymerization of Propylene, by Wayne "E" Smith; 5. Anionic Polymerization, by Maurice Morton; 6. Mechanisms of Cationic Polymerization, by Z. Zlamal; and 7. Radiation-Induced Polymerization, by Yoneho Tabata.

Both the industrial and academic polymer scientist will find these books very useful.

C. V. R.

Aspects of Allergy and Applied Immunology (Vol. II). Editors: R. Viswanathan, R. K. Sanyal, G. Bazaz Malik, S. Arora and B. D. Miglani. (Published by New Heights, M/1024, Darya Ganj, New Delhi-6), Pp. 196. Price Rs. 30.

The volume under review contains the proceedings of the Second Convention of the Indian College of Allergy and Applied Immunology, held in the V. Patel Chest Institute, Delhi University, on 21 and 22 December 1968. It includes the full text of 25 papers presented at the Convention by nearly 40 workers in this field of research and discussions which followed each paper. It also contains the Presidential Address by Prof. R. K. Sanyal, the I.C.A.I. Oration by Prof. R. Viswanathan, and a special lecture by Dr. S. C. Lahiri.

The contents represent the current state of research on allergy, applied immunology and related problems in India.

A. S. G.

Fungi of South India. By G. Rangaswami, V. S. Seshadri and K. A. Lucy Channamma. (The University of Agricultural Sciences, Hebbal, Bangalore-24), 1970. Pp. xv + 193.

This index on the fungal flora of South India is the outcome of studies undertaken by the authors under PL 480 Grant scheme through the US Department of Agriculture, Far Eastern Regional Research Office. In the present hand-book the authors have attempted to bring together all fungi recorded from South India upto the end of 1968. For the purpose the present States of Andhra, Madras, Mysore, Kerala and Pondicherry have been included. In all, 2,019 fungi representing 567 genera have been listed.

The contents are arranged under 1. List of Fungi, pp. 1-92; 2. Bibliography, pp. 93-140; 3. Host Index, pp. 141-186; and 4. List of Genera, pp. 187-193.

The hand-book will be a useful supplement to the already existing literature on the subject.

A. S. G.

Fundamentals of Agricultural Microbiology. By K. C. Mahanta. (Published by Oxford and IBH Publishing Co., 17, Park Street, Calcutta-16), 1969. Pp. vi + 416. Price Rs. 16.

Microbiological activities play an important role in agriculture, and the study of general microbiology is an essential part of the curriculum of the graduate course students of agriculture. The author who is an experienced teacher of microbiology in agricultural institutions, has presented the subject in a clear, readable and interesting manner. The coverage includes morphology, classification and metabolism of microorganisms, microbiological techniques, fermentation, soil microbiology, microbiology of water and air, dairy microbiology and microbiology of food and food products. The text is amply illustrated.

Although written essentially as a text-book for students in Agricultural Colleges, the book will appeal to workers in other disciplines who may wish to know the fundamentals of microbiology and the experimental techniques involved in its study.

A. S. G.

Books Received

Programmed Study Aid for Introductory Physics. By J. A. Taylor. Part I. *Mechanics*, Pp. 177, Price 35 *sh*. Part II. *Electricity and Magnetism*, Pp. 181, Price 35 *sh*. (Addison-Wesley Pub. Co., Inc., London W. 1, England).

Logic and Proof. By M. L. Bitting. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 129. Price 26 *sh*.

Climate and Weather. By J. A. Day and G. L. Sternes. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 407. Price 100 *sh*.

Introduction to Laboratory Chemistry—General. By A. L. Williams, R. W. Richardson, H. J. Debey, L. A. Kelly and O. G. Lien. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 197. Price not given.

2247-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

THE INDIAN ACADEMY OF SCIENCES : XXXVI ANNUAL MEETING

THE Thirty-Sixth Annual Meeting of the Indian Academy of Sciences was held at the Raman Research Institute, Bangalore, from the 7th to the 12th September 1970. It may be noted that this was the first time, since the inception of the Academy in 1934, that its Annual Meeting was held at the Academy's headquarters itself.

The week long meeting, which was made purposeful, had for its daily programme (*i*) an invited lecture followed by discussions from 10 a.m. to 12 noon, (*ii*) group discussions from 2 p.m. to 5 p.m. on a major subject of current interest at which active workers on various aspects of the subject presented their problems and the results of their investigations, and (*iii*) an evening lecture from 5–30 p.m. to 6–30 p.m. About a hundred scientists including Fellows, Invitees and Delegates attended the meeting.

After the Business Meeting of the Fellows, the plenary session opened at 10 a.m. on Monday, the 7th September 1970 with a general assembly of Fellows, Invitees and Delegates at which the President in an introductory speech welcomed the gathering of scientists. This was followed by informative talks and exchange of ideas on current progress of science in various countries of the world in which a number of speakers took part. Dr. L. A. Ramdas, Emeritus Scientist at the NPL, gave a talk on the possible reclamation of alkali-ridden soils. Dr. P. R. Pisharoty (Physical Research Laboratory, Ahmedabad) recounted his impressions of a recent visit to a Meteorological Observatory in Siberia.

The Council of the Academy were *at-home* to the guests in the evening.

Sir C. V. Raman, President of the Academy and Nobel Laureate, delivered his Presidential Address on "The Origins of Floral Colours".

The invited lecture of the morning session of the second day was given by Dr. S. Chandrasekhar (University of Mysore) on "Liquid Crystals" in which he gave a survey of the latest researches on the subject including the work done by his group at the Mysore University. At his request his co-worker Mr. Madhusudan supplemented the lecture by a short talk on the structure of some organic molecules which exhibit liquid crystal characteristics.

The subject for the group discussions for the afternoon session was "The Brain and its Functions". Dr. R. M. Varma (Director, All-India Institute of Mental Health, Bangalore) took the Chair. Six speakers dealt with different aspects of the subject, each a specialist in his field of study. Dr. Sharma (St. John's Medical College, Bangalore) spoke on "Neurophysiology", Dr. B. K. Bachhawat (Medical Hospital, Vellore) on "Neurochemistry, Dr. M. Sirsi (Indian Institute of Science, Bangalore) on "Neuropharmacology", Dr. S. Kalyanaraman (Government General Hospital, Madras) on "Neurosurgery", Dr. K. S. Mani (All-India Institute of Mental Health, Bangalore) on "Neuromedicine", and Dr. R. L. Kapur (All-India Institute of Mental Health) on "Psychiatry".

The evening lecture on the second day under the Chairmanship of Dr. R. Ananthakrishnan (Director, Institute of Tropical Meteorology, Poona) was delivered by Dr. M. K. Vainu Bappu (Director, Kodaikanal Solar Observatory) on "Solar Eclipses" in which the lecturer made special references to coronal studies and the observations of the solar eclipse of March 7, 1970 by the Indian team which he led to Mexico.

The morning lecture on the third day was by Dr. R. Ramanna (Director, Physics Group, BARC, Bombay) on "Atomic Nuclei" in which he discussed a new mathematical approach to the problem of binding energy in atomic nuclei.

The group discussions on "Earthquakes" in the afternoon were held under the Chairmanship of Dr. K. R. Ramanathan (Director, Physical Research Laboratory, Ahmedabad) who in his introductory speech traced the history and current status of "Seismology in India". Dr. B. P. Radhakrishna (Director, Department of Mines and Geology, Bangalore) spoke on "Indian Geology with reference to Seismology" in which he advanced arguments to show that the Deccan Plateau is not to be regarded as a seismologically quiescent zone. Mr. M. B. Ramachandra Rao (Former Member, Oil and Natural Gas Commission, India) spoke about some significant findings met with during the drilling-for-oil operations in India, which had special reference to the theory of isostasy. Dr. Kaila (NGI, Hyderabad) gave a detailed account of the work being done at the National Geophysical Institute in his talk on "Seismological Studies at Hyderabad". Mr. T. G. Varghese in his talk on "Earthquake Data from Gauribidanur" gave an account of the working

Volume 2 deals with ring-opening reactions, and Volume 3 with condensation reactions.

The chapters contained in this volume under review are: 1. The Mechanism of Emulsion Polymerization, by John W. Vanderhoff; 2. Elucidation of Emulsion Polymerization Mechanism Based upon Copolymer Studies, by W. Frank Fowler, Jr.; 3. Mechanism of the Emulsion Polymerization of Ethylene, by Harry K. Stryker, Gerald J. Mantell, and Arthur F. Helin; 4. The Mechanism of Stereospecific Polymerization of Propylene, by Wayne "E" Smith; 5. Anionic Polymerization, by Maurice Morton; 6. Mechanisms of Cationic Polymerization, by Z. Zlamal; and 7. Radiation-Induced Polymerization, by Yoneho Tabata.

Both the industrial and academic polymer scientist will find these books very useful.

C. V. R.

Aspects of Allergy and Applied Immunology (Vol. II). Editors: R. Viswanathan, R. K. Sanyal, G. Bazaz Malik, S. Arora and B. D. Miglani. (Published by New Heights, M/1024, Darya Ganj, New Delhi-6), Pp. 196. Price Rs. 30.

The volume under review contains the proceedings of the Second Convention of the Indian College of Allergy and Applied Immunology, held in the V. Patel Chest Institute, Delhi University, on 21 and 22 December 1968. It includes the full text of 25 papers presented at the Convention by nearly 40 workers in this field of research and discussions which followed each paper. It also contains the Presidential Address by Prof. R. K. Sanyal, the I.C.A.I. Oration by Prof. R. Viswanathan, and a special lecture by Dr. S. C. Lahiri.

The contents represent the current state of research on allergy, applied immunology and related problems in India.

A. S. G.

Fungi of South India. By G. Rangaswami, V. S. Seshadri and K. A. Lucy Channamma. (The University of Agricultural Sciences, Hebbal, Bangalore-24), 1970. Pp. xv + 193.

This index on the fungal flora of South India is the outcome of studies undertaken by the authors under PL 480 Grant scheme through the US Department of Agriculture, Far Eastern Regional Research Office. In the present hand-book the authors have attempted to bring together all fungi recorded from South India upto the end of 1968. For the purpose the present States of Andhra, Madras, Mysore, Kerala and Pondicherry have been included. In all, 2,019 fungi representing 567 genera have been listed.

The contents are arranged under 1. List of Fungi, pp. 1-92; 2. Bibliography, pp. 93-140; 3. Host Index, pp. 141-186; and 4. List of Genera, pp. 187-193.

The hand-book will be a useful supplement to the already existing literature on the subject.

A. S. G.

Fundamentals of Agricultural Microbiology. By K. C. Mahanta. (Published by Oxford and IBH Publishing Co., 17, Park Street, Calcutta-16), 1969. Pp. vi + 416. Price Rs. 16.

Microbiological activities play an important role in agriculture, and the study of general microbiology is an essential part of the curriculum of the graduate course students of agriculture. The author who is an experienced teacher of microbiology in agricultural institutions, has presented the subject in a clear, readable and interesting manner. The coverage includes morphology, classification and metabolism of microorganisms, microbiological technique, fermentation, soil microbiology, microbiology of water and air, dairy microbiology and microbiology of food and food products. The text is amply illustrated.

Although written essentially as a text-book for students in Agricultural Colleges, the book will appeal to workers in other disciplines who may wish to know the fundamentals of microbiology and the experimental techniques involved in its study.

A. S. G.

Books Received

Programmed Study Aid for Introductory Physics. By J. A. Taylor. Part I. *Mechanics*, Pp. 177, Price 35 *sh.*; Part II. *Electricity and Magnetism.* Pp. 181. Price 35 *sh.* (Addison-Wesley Pub. Co., Inc., London W. 1, England.)

Logic and Proof. By M. L. Billing. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 129. Price 26 *sh.*

Climate and Weather. By J. A. Day and G. L. Sternes. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 407. Price 100 *sh.*

Introduction to Laboratory Chemistry: General. By A. L. Williams, R. W. Richardson, H. J. Debey, L. A. Kelly and O. G. Lien. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 197. Price not given.

2247-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

THE INDIAN ACADEMY OF SCIENCES : XXXVI ANNUAL MEETING

THE Thirty-Sixth Annual Meeting of the Indian Academy of Sciences was held at the Raman Research Institute, Bangalore, from the 7th to the 12th September 1970. It may be noted that this was the first time, since the inception of the Academy in 1934, that its Annual Meeting was held at the Academy's headquarters itself.

The week long meeting, which was made purposeful, had for its daily programme (*i*) an invited lecture followed by discussions from 10 a.m. to 12 noon, (*ii*) group discussions from 2 p.m. to 5 p.m. on a major subject of current interest at which active workers on various aspects of the subject presented their problems and the results of their investigations, and (*iii*) an evening lecture from 5 30 p.m. to 6 30 p.m. About a hundred scientists including Fellows, Invitees and Delegates attended the meeting.

After the Business Meeting of the Fellows, the plenary session opened at 10 a.m. on Monday, the 7th September 1970 with a general assembly of Fellows, Invitees and Delegates at which the President in an introductory speech welcomed the gathering of scientists. This was followed by informative talks and exchange of ideas on current progress of science in various countries of the world in which a number of speakers took part. Dr L. A. Ramdas, Emeritus Scientist at the NPL, gave a talk on the possible reclamation of alkali-ridden soils. Dr. P R. Pisharoty (Physical Research Laboratory, Ahmedabad) recounted his impressions of a recent visit to a Meteorological Observatory in Siberia.

The Council of the Academy were *at-home* to the guests in the evening.

Sir C. V. Raman, President of the Academy and Nobel Laureate, delivered his Presidential Address on "The Origins of Floral Colours".

The invited lecture of the morning session of the second day was given by Dr. S. Chandrasekhar (University of Mysore) on "Liquid Crystals" in which he gave a survey of the latest researches on the subject including the work done by his group at the Mysore University. At his request his co-worker Mr. Madhusudan supplemented the lecture by a short talk on the structure of some organic molecules which exhibit liquid crystal characteristics.

The subject for the group discussions for the afternoon session was "The Brain and its Functions". Dr. R. M. Varma (Director, All-India Institute of Mental Health, Bangalore) took the Chair. Six speakers dealt with different aspects of the subject, each a specialist in his field of study. Dr. Sharma (St. John's Medical College, Bangalore) spoke on "Neurophysiology", Dr. B. K. Bachhawat (Medical Hospital, Vellore) on "Neurochemistry, Dr. M. Sirsi (Indian Institute of Science, Bangalore) on "Neuropharmacology", Dr. S. Kalyanaraman (Government General Hospital, Madras) on "Neurosurgery", Dr. K. S. Mani (All-India Institute of Mental Health, Bangalore) on "Neuromedicine", and Dr. R. L. Kapur (All-India Institute of Mental Health) on "Psychiatry".

The evening lecture on the second day under the Chairmanship of Dr. R. Ananthakrishnan (Director, Institute of Tropical Meteorology, Poona) was delivered by Dr. M. K. Vainu Bappu (Director, Kodaikanal Solar Observatory) on "Solar Eclipses" in which the lecturer made special references to coronal studies and the observations of the solar eclipse of March 7, 1970 by the Indian team which he led to Mexico.

The morning lecture on the third day was by Dr. R. Ramanna (Director, Physics Group, BARC, Bombay) on "Atomic Nuclei" in which he discussed a new mathematical approach to the problem of binding energy in atomic nuclei.

The group discussions on "Earthquakes" in the afternoon were held under the Chairmanship of Dr. K. R. Ramanathan (Director, Physical Research Laboratory, Ahmedabad) who in his introductory speech traced the history and current status of "Seismology in India". Dr. B. P. Radhakrishna (Director, Department of Mines and Geology, Bangalore) spoke on "Indian Geology with reference to Seismology" in which he advanced arguments to show that the Deccan Plateau is not to be regarded as a seismologically quiescent zone. Mr. M. B. Ramachandra Rao (Former Member, Oil and Natural Gas Commission, India) spoke about some significant findings met with during the drilling-for-oil operations in India, which had special reference to the theory of isostasy. Dr. Kaila (NGI, Hyderabad) gave a detailed account of the work being done at the National Geophysical Institute in his talk on "Seismological Studies at Hyderabad". Mr. T. G. Varghese in his talk on "Earthquake Data from Gauribidanur" gave an account of the working

Volume 2 deals with ring-opening reactions, and Volume 3 with condensation reactions.

The chapters contained in this volume under review are: 1. The Mechanism of Emulsion Polymerization, by John W. Vanderhoff; 2. Elucidation of Emulsion Polymerization Mechanism Based upon Copolymer Studies, by W. Frank Fowler, Jr.; 3. Mechanism of the Emulsion Polymerization of Ethylene, by Harry K. Stryker, Gerald J. Mantell, and Arthur F. Helin; 4. The Mechanism of Stereospecific Polymerization of Propylene, by Wayne "E" Smith; 5. Anionic Polymerization, by Maurice Morton; 6. Mechanisms of Cationic Polymerization, by Z. Zlamal; and 7. Radiation-Induced Polymerization, by Yoneho Tabata.

Both the industrial and academic polymer scientist will find these books very useful.

C. V. R.

Aspects of Allergy and Applied Immunology (Vol. II). Editors: R. Viswanathan, R. K. Sanyal, G. Bazaz Malik, S. Arora and B. D. Miglani. (Published by New Heights, M/1024, Darya Ganj, New Delhi-6), Pp. 196. Price Rs. 30.

The volume under review contains the proceedings of the Second Convention of the Indian College of Allergy and Applied Immunology, held in the V. Patel Chest Institute, Delhi University, on 21 and 22 December 1968. It includes the full text of 25 papers presented at the Convention by nearly 40 workers in this field of research and discussions which followed each paper. It also contains the Presidential Address by Prof. R. K. Sanyal, the I.C.A.I. Oration by Prof. R. Viswanathan, and a special lecture by Dr. S. C. Lahiri.

The contents represent the current state of research on allergy, applied immunology and related problems in India.

A. S. G.

Fungi of South India. By G. Rangaswami, V. S. Seshadri and K. A. Lucy Channamma. (The University of Agricultural Sciences, Hebbal, Bangalore-24), 1970. Pp. xv + 193.

This index on the fungal flora of South India is the outcome of studies undertaken by the authors under PL 480 Grant scheme through the US Department of Agriculture, Far Eastern Regional Research Office. In the present hand-book the authors have attempted to bring together all fungi recorded from South India upto the end of 1968. For the purpose the present State of Andhra, Madras, Mysore, Kerala and Pondicherry have been included. In all, 2,019 fungi representing 567 genera have been listed.

The contents are arranged under 1. List of Fungi, pp. 1-92; 2. Bibliography, pp. 93-140; 3. Host Index, pp. 141-186; and 4. List of Genera, pp. 187-193.

The hand-book will be a useful supplement to the already existing literature on the subject.

A. S. G.

Fundamentals of Agricultural Microbiology. By K. C. Mahanta. (Published by Oxford and IBH Publishing Co., 17, Park Street, Calcutta-16), 1969. Pp. vi + 416. Price Rs. 16.

Microbiological activities play an important role in agriculture, and the study of general microbiology is an essential part of the curriculum of the graduate course students of agriculture. The author who is an experienced teacher of microbiology in agricultural institutions, has presented the subject in a clear, readable and interesting manner. The coverage includes morphology, classification and metabolism of microorganisms, microbiological techniques, fermentation, soil microbiology, microbiology of water and air, dairy microbiology and microbiology of food and food products. The text is amply illustrated.

Although written essentially as a text-book for students in Agricultural Colleges, the book will appeal to workers in other disciplines who may wish to know the fundamentals of microbiology and the experimental techniques involved in its study.

A. S. G.

Books Received

Programmed Study Aid for Introductory Physics. By J. A. Taylor. Part I. *Mechanics*, Pp. 177, Price 35 *sh.*; Part II. *Electricity and Magnetism*, Pp. 181, Price 35 *sh.* (Addison-Wesley Pub. Co., Inc., London W. 1, England).

Logic and Proof. By M. L. Bitting. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 129. Price 26 *sh.*

Climate and Weather. By J. A. Day and G. L. Sternes. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 407. Price 100 *sh.*

Introduction to Laboratory Chemistry: General. By A. L. Williams, R. W. Richardson, H. J. Debey, L. A. Kelly and O. G. Lien. (Addison-Wesley Pub. Co., Inc., London W. 1, England), 1970. Pp. 197. Price not given.

2247-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

THE INDIAN ACADEMY OF SCIENCES : XXXVI ANNUAL MEETING

THE Thirty-Sixth Annual Meeting of the Indian Academy of Sciences was held at the Raman Research Institute, Bangalore, from the 7th to the 12th September 1970. It may be noted that this was the first time, since the inception of the Academy in 1934, that its Annual Meeting was held at the Academy's headquarters itself.

The week long meeting, which was made purposeful, had for its daily programme (*i*) an invited lecture followed by discussions from 10 a.m. to 12 noon, (*ii*) group discussions from 2 p.m. to 5 p.m. on a major subject of current interest at which active workers on various aspects of the subject presented their problems and the results of their investigations, and (*iii*) an evening lecture from 5–30 p.m. to 6–30 p.m. About a hundred scientists including Fellows, Invitees and Delegates attended the meeting.

After the Business Meeting of the Fellows, the plenary session opened at 10 a.m. on Monday, the 7th September 1970 with a general assembly of Fellows, Invitees and Delegates at which the President in an introductory speech welcomed the gathering of scientists. This was followed by informative talks and exchange of ideas on current progress of science in various countries of the world in which a number of speakers took part. Dr. L. A. Ramdas, Emeritus Scientist at the NPL, gave a talk on the possible reclamation of alkali-ridden soils. Dr. P. R. Pisharoty (Physical Research Laboratory, Ahmedabad) recounted his impressions of a recent visit to a Meteorological Observatory in Siberia.

The Council of the Academy were *at-home* to the guests in the evening.

Sir C. V. Raman, President of the Academy and Nobel Laureate, delivered his Presidential Address on "The Origins of Floral Colours".

The invited lecture of the morning session of the second day was given by Dr. S. Chandrasekhar (University of Mysore) on "Liquid Crystals" in which he gave a survey of the latest researches on the subject including the work done by his group at the Mysore University. At his request his co-worker Mr. Madhusudan supplemented the lecture by a short talk on the structure of some organic molecules which exhibit liquid crystal characteristics.

The subject for the group discussions for the afternoon session was "The Brain and its Functions". Dr. R. M. Varma (Director, All-Inc Institute of Mental Health, Bangalore) to the Chair. Six speakers dealt with differe aspects of the subject, each a specialist in field of study. Dr. Sharma (St. John's Medi College, Bangalore) spoke on "Neurophysiolog Dr. B. K. Bachhawat (Medical Hospital, Vello on "Neurochemistry, Dr. M. Sirsi (Indi Institute of Science, Bangalore) on "Neur pharmacology", Dr. S. Kalyanaraman (Gover ment General Hospital, Madras) on "Neurosu gery", Dr. K. S. Mani (All-India Institute Mental Health, Bangalore) on "Neuromedicin and Dr. R. L. Kapur (All-India Institute Mental Health) on "Psychiatry".

The evening lecture on the second d under the Chairmanship of Dr. R. Ananth krishnan (Director, Institute of Tropi Meteorology, Poona) was delivered by Dr. M. Vainu Bappu (Director, Kodaikanal Sol Observatory) on "Solar Eclipses" in which t lecturer made special references to coro studies and the observations of the solar ecli of March 7, 1970 by the Indian team which led to Mexico.

The morning lecture on the third day w by Dr. R. Ramanna (Director, Physics Grou BARC, Bombay) on "Atomic Nuclei" in whi he discussed a new mathematical approach the problem of binding energy in atomic nucl

The group discussions on "Earthquakes" the afternoon were held under the Chairma ship of Dr. K. R. Ramanathan (Director, Phy cal Research Laboratory, Ahmedabad) who his introductory speech traced the history a current status of "Seismology in Indi Dr. B. P. Radhakrishna (Director, Departm of Mines and Geology, Bangalore) spoke "Indian Geology with reference to Seismolo in which he advanced arguments to show t the Deccan Plateau is not to be regarded a seismologically quiescent zone. Mr. M. Ramachandra Rao (Former Member, Oil a Natural Gas Commission, India) spoke ab some significant findings met with during drilling-for-oil operations in India, which special reference to the theory of isosta Dr. Kaila (NGI, Hyderabad) gave a detai account of the work being done at the Natio Geophysical Institute in his talk on "Seism logical Studies at Hyderabad". Mr. T. Varghese in his talk on "Earthquake Data fr Gauribidanur" gave an account of the work

and performance of the precision instruments installed in Gauribidanur near Bangalore for the detection and supply of data on earthquakes and underground nuclear tests which may be carried out at any part of the world. Dr. R. Ramanna showed some slides of recent measurements carried out on skyscraper buildings in America to study the effects of underground nuclear explosions. Dr. S. K. Chakrabarty (Department of Applied Mathematics, University College of Science, Calcutta) spoke on "Theoretical Seismology" and Prof. V. R. Thiruvenkatachar on "Mathematical Models in Seismology".

The evening lecture was on "Modern Meteorology" by Miss Anna Mani (Deputy Director-General of Observatories, New Delhi) in which she dealt chiefly with satellite meteorology. The lecture concluded with a 15-minute film show of cloud photographs depicting 10 day, 5 day, and daily changes of cloud patterns over the globe, as transmitted by the meteorological satellites circling the earth.

The invited lecture on the morning of the fourth day was on "Molecular Structure" by Dr. C. N. R. Rao (Indian Institute of Technology, Kanpur). Dr. Rao in his lecture gave a clear exposition of our present state of knowledge on the structure of H_2O, the water molecule, as revealed by latest techniques by chemical, physical, and spectroscopic methods.

The topic for the group discussions for this day's afternoon session was "Plant Diseases". Eleven speakers presented their subjects each in a 15-minute talk followed by discussions. Prof. T. S. Sadasivan (Director, University Botany Laboratory, Madras), who chaired the meeting, in his introductory talk made special reference to experiments with isolated protoplasts. Dr. S. Suryanarayana (Department of Botany, University of Madras) spoke on "Environment and Disease"; Dr. R. Kalyanasundaram (University of Madras) on "Plant Immunity and Resistance"; Dr. D. Subramanian (Department of Botany, University of Madras) on "Phytoallergins"; and Dr. V. Agnihothrudu (Technical Adviser, Rallis India, Ltd.) on "Chemical Control of Fungal Diseases". These were followed by the Coimbatore Agricultural College Research group headed by Dr. K. Ramakrishnan who spoke on "General Virology", Dr. K. K. N. Nambiar on "Patho-physiology of Virus Diseases", Mr. A. Anjaneyulu on "Mycoplasma/PPLO-induced Pathogenesis in Plants", and Mr. T. K. Kandaswami on "Control of Virus Diseases". Finally, Dr. G. Rangaswami (Dean, University of Agricultural Sciences, Bangalore) spoke on "Bacteriology and Soil Microbiology", and Dr. S. Y. Padmanabhan (Director, Rice Research Institute, Cuttack) on "Breeding for Disease Resistance in Rice".

The evening lecture on the fourth day was delivered by Dr. R. M. Varma (Director, All-India Institute of Mental Health, Bangalore) on "Brain and Mind".

The proceedings of the fifth day of the session started with the lecture on "Radio Astronomy" by Dr. Govind Swarup, (Radio Astronomy Division, TIFR, Ooty). The lecturer in his survey of the subject spoke on Radio-Sources, Moon's Occultation, Inter-planetary Medium, and Pulsars, and made special reference to the potentialities of the newly installed Radio Telescope at Ooty which has gone into action.

The group discussions in the afternoon was on "Aeronautics" in which four experts took part. Dr. V. M. Ghatage (General Manager, Hindustan Aeronautics Ltd., Bangalore) who chaired the meeting spoke on "Some Specific Problems in the Design of an Aircraft". Among the problems he discussed were Static Pressure Measurements, After Body Drag, and Interference. This was followed by a talk by Prof. Satish Dhawan (Director, Indian Institute of Science, Bangalore) on "Breakdown of Laminar Motion". Prof. R. Narasimha (Indian Institute of Science, Bangalore) spoke on "Shock Wave Structure". The last speaker was Dr. S. R. Valluri (Director, National Aeronautical Laboratory, Bangalore) who spoke on "Some Aspects of Fatigue Failure".

The evening lecture of the day was on "Our Mineral Resources" by Dr. B. P. Radhakrishna (Director, Department of Mines and Geology, Bangalore).

On the sixth and last day of the meeting the morning invited lecture was given under the Chairmanship of Dr. S. Dhawan, by Dr. S. Ramaseshan (National Aeronautical Laboratory, Bangalore) on "Materials Science". The lecturer reviewed the current progress in the field of Stress/Strain relations in alloys and composite materials, and discussed the problems his group is tackling at the NAL on fibre reinforcement technique and the new technique of electrolytic deposition of thin layers in matrix materials. At his request his collaborator Mr. Rangarajan supplemented the lecture

by a short talk on the mathematics involved in the above technique.

The afternoon group discussions were on "The Structure of the Galaxy" in which the following specialists spoke on the subject mentioned against each: Dr. K. D. Abhyanker (Nizam's Observatory, Hyderabad) on "Kinematical Features of the Galaxy"; Dr. J. C. Bhattacharyya (Kodaikanal Observatory) on "Brightness Distribution of the Milky Way in the UV, Visual and Infrared Regions"; Dr. G. Swarup on "Radio Continuum and Line Radiation Characteristic of the Galaxy"; Dr. M. K. Vainu Bappu on "Optical Aspects of Spiral Structure of the Galaxy"; Mr. Ch. V. Sastry on "Low Frequency Detection of Ionized Hydrogen Regions"; Dr. B. V. Sreekantan (Tata Institute of Fundamental Research, Bombay) on "Gamma-rays, X-rays and the Galaxy"; and Dr. R. R. Daniel (TIFR, Bombay) on "Cosmic Rays and the Structure of the Galaxy".

The evening lecture was given by Dr. V. Prabhakar Rao (Entomologist-in-Charge, Commonwealth Institute of Biological Control, Bangalore) on "Insect Control".

The Session concluded with an expression of thanks by the President Sir C. V. Raman, to all the Fellows, Invitees and Delegates who by making this "contact of minds" possible contributed to the success of the meeting.

DIFFERENTIAL INTERACTION OF MARINE HUMIC AND FULVIC ACIDS WITH ALKALINE EARTH AND RARE EARTH ELEMENTS

M. V. M. DESAI, ELIZABETH MATHEW AND A. K. GANGULY

Health Physics Division, Bhabha Atomic Research Centre, Trombay, Bombay-85, India

ABSTRACT

Alkaline earth sulphates such as of Ba and Ra and rare earth hydroxides such as of Y, La and Ac were solubilized significantly by marine humic and fulvic acids in ammoniacal medium. Alkaline earth elements were associated with humic and fulvic acids as exchangeable cationic and/or cationic complexes whereas rare earth elements formed non-cationic complexes. Major fraction of humic acid precipitates in sea water and this settling humic acid picks up only rare earth elements from alkaline earth-rare earth radioactive pairs. These rare earths were associated with humic acid as non-cationic complexes. The dissolved fraction of humic acid in sea water also had the rare earths in non-cationic complex forms.

INTRODUCTION

HUMIC ACID (in ammoniacal medium) solubilises a large number of elements.[1] Solubilized Ba was found to be associated with the cation exchange sites of humic acid and the total solubilization of $BaSO_4$ was observed to be equivalent to the exchange capacity.[1] Solubilized transition and trivalent elements such as Zn, Mn, Cu, Co, Fe and Y are bound with the humic acid mostly as non-cationic complexes and small fractions were observed to be exchangeable on a cation column.

Humic acid precipitates in sea-water and picks up in the process a variety of major and trace elements present in the medium. In the light of the above observations and the presence of high concentrations of Mg and Ca, other alkaline earth elements are not expected to be significantly picked up by the settling humic acid. Results presented in Table I also support this contention. However, it has been observed that Y is almost quantitatively picked up by the settling humic acid under similar conditions.[1]

TABLE I*

Pick-up of $^{85-89}Sr$ by humic acid (sea-water medium)

Time (days)	Activity in cpm per ml. in filtrate	
	Blank	Sample
0·17	1643	1633
7	1416	1370
15	1306	1293
22	1238	1230
33	1083	1071

* Humic acid sol. 12·8 mg. (exchange capacity 383 meq per 100 g.) in 100 ml $^{85-89}Sr$ (carrier content - 1·86 mg.), spiked sea water was left with intermittent shaking. Aliquots filtered from time to time, filtrate counts compared with that of the blank.

In this paper, further results are presented on the nature of this differential interaction of humic and fulvic acids with alkaline earth and rare earth elements. Discussions follow each of the experiments.

and performance of the precision instruments installed in Gauribidanur near Bangalore for the detection and supply of data on earthquakes and underground nuclear tests which may be carried out at any part of the world. Dr. R. Ramanna showed some slides of recent measurements carried out on skyscraper buildings in America to study the effects of underground nuclear explosions. Dr. S. K. Chakrabarty (Department of Applied Mathematics, University College of Science, Calcutta) spoke on "Theoretical Seismology" and Prof. V. R. Thiruvenkatachar on "Mathematical Models in Seismology".

The evening lecture was on "Modern Meteorology" by Miss Anna Mani (Deputy Director-General of Observatories, New Delhi) in which she dealt chiefly with satellite meteorology. The lecture concluded with a 15-minute film show of cloud photographs depicting 10 day, 5 day, and daily changes of cloud patterns over the globe, as transmitted by the meteorological satellites circling the earth.

The invited lecture on the morning of the fourth day was on "Molecular Structure" by Dr. C. N. R. Rao (Indian Institute of Technology, Kanpur). Dr. Rao in his lecture gave a clear exposition of our present state of knowledge on the structure of H_2O, the water molecule, as revealed by latest techniques by chemical, physical, and spectroscopic methods.

The topic for the group discussions for this day's afternoon session was "Plant Diseases". Eleven speakers presented their subjects each in a 15-minute talk followed by discussions. Prof. T. S. Sadasivan (Director, University Botany Laboratory, Madras), who chaired the meeting, in his introductory talk made special reference to experiments with isolated protoplasts. Dr. S. Suryanarayana (Department of Botany, University of Madras) spoke on "Environment and Disease"; Dr. R. Kalyanasundaram (University of Madras) on "Plant Immunity and Resistance"; Dr. D. Subramanian (Department of Botany, University of Madras) on "Phytoallergins"; and Dr. V. Agnihothrudu (Technical Adviser, Rallis India, Ltd.) on "Chemical Control of Fungal Diseases". These were followed by the Coimbatore Agricultural College Research group headed by Dr. K. Ramakrishnan who spoke on "General Virology", Dr. K. K. N. Nambiar on "Patho-physiology of Virus Diseases", Mr. A. Anjaneyulu on "Mycoplasma/PPLO-induced Pathogenesis in Plants", and Mr. T. K. Kandaswami on "Control of Virus Diseases". Finally, Dr. G. Rangaswami (Dean, University of Agricultural Sciences, Bangalore) spoke on "Bacteriology and Soil Microbiology", and Dr. S. Y. Padmanabhan (Director, Rice Research Institute, Cuttack) on "Breeding for Disease Resistance in Rice".

The evening lecture on the fourth day was delivered by Dr. R. M. Varma (Director, All-India Institute of Mental Health, Bangalore) on "Brain and Mind".

The proceedings of the fifth day of the session started with the lecture on "Radio Astronomy" by Dr. Govind Swarup, (Radio Astronomy Division, TIFR, Ooty). The lecturer in his survey of the subject spoke on Radio-Sources, Moon's Occultation, Inter-planetary Medium, and Pulsars, and made special reference to the potentialities of the newly installed Radio Telescope at Ooty which has gone into action.

The group discussions in the afternoon was on "Aeronautics" in which four experts took part. Dr. V. M. Ghatage (General Manager, Hindustan Aeronautics Ltd., Bangalore) who chaired the meeting spoke on "Some Specific Problems in the Design of an Aircraft". Among the problems he discussed were Static Pressure Measurements, After Body Drag, and Interference. This was followed by a talk by Prof. Satish Dhawan (Director, Indian Institute of Science, Bangalore) on "Breakdown of Laminar Motion". Prof. R. Narasimha (Indian Institute of Science, Bangalore) spoke on "Shock Wave Structure". The last speaker was Dr. S. R. Valluri (Director, National Aeronautical Laboratory, Bangalore) who spoke on "Some Aspects of Fatigue Failure".

The evening lecture of the day was on "Our Mineral Resources" by Dr. B. P. Radhakrishna (Director, Department of Mines and Geology, Bangalore).

On the sixth and last day of the meeting the morning invited lecture was given under the Chairmanship of Dr. S. Dhawan, by Dr. S. Ramaseshan (National Aeronautical Laboratory, Bangalore) on "Materials Science". The lecturer reviewed the current progress in the field of Stress/Strain relations in alloys and composite materials, and discussed the problems his group is tackling at the NAL on fibre reinforcement technique and the new technique of electrolytic deposition of thin layers in matrix materials. At his request his collaborator Mr. Rangarajan supplemented the lecture

by a short talk on the mathematics involved in the above technique.

The afternoon group discussions were on "The Structure of the Galaxy" in which the following specialists spoke on the subject mentioned against each: Dr. K. D. Abhyanker (Nizam's Observatory, Hyderabad) on "Kinematical Features of the Galaxy"; Dr. J. C. Bhattacharyya (Kodaikanal Observatory) on "Brightness Distribution of the Milky Way in the UV, Visual and Infrared Regions"; Dr. G. Swarup on "Radio Continuum and Line Radiation Characteristic of the Galaxy"; Dr. M. K. Vainu Bappu on "Optical Aspects of Spiral Structure of the Galaxy"; Mr. Ch. V. Sastry on "Low Frequency Detection of Ionized Hydrogen Regions"; Dr. B. V. Sreekantan (Tata Institute of Fundamental Research, Bombay) on "Gamma-rays, X-rays and the Galaxy"; and Dr. R. R. Daniel (TIFR, Bombay) on "Cosmic Rays and the Structure of the Galaxy".

The evening lecture was given by Dr. V. Prabhakar Rao (Entomologist-in-Charge, Commonwealth Institute of Biological Control, Bangalore) on "Insect Control".

The Session concluded with an expression of thanks by the President Sir C. V. Raman, to all the Fellows, Invitees and Delegates who by making this "contact of minds" possible contributed to the success of the meeting.

DIFFERENTIAL INTERACTION OF MARINE HUMIC AND FULVIC ACIDS WITH ALKALINE EARTH AND RARE EARTH ELEMENTS

M. V. M. DESAI, ELIZABETH MATHEW AND A. K. GANGULY

Health Physics Division, Bhabha Atomic Research Centre, Trombay, Bombay-85, India

ABSTRACT

Alkaline earth sulphates such as of Ba and Ra and rare earth hydroxides such as of Y, La and Ac were solubilized significantly by marine humic and fulvic acids in ammoniacal medium. Alkaline earth elements were associated with humic and fulvic acids as exchangeable cationic and/or cationic complexes whereas rare earth elements formed non-cationic complexes. Major fraction of humic acid precipitates in sea-water and this settling humic acid picks up only rare earth elements from alkaline earth-rare earth radioactive pairs. These rare earths were associated with humic acid as non-cationic complexes. The dissolved fraction of humic acid in sea-water also had the rare earths in non-cationic complex forms.

INTRODUCTION

HUMIC ACID (in ammoniacal medium) solubilizes a large number of elements.[1] Solubilized Ba was found to be associated with the cation exchange sites of humic acid and the total solubilization of $BaSO_4$ was observed to be equivalent to the exchange capacity.[1] Solubilized transition and trivalent elements such as Zn, Mn, Cu, Co, Fe and Y are bound with the humic acid mostly as non-cationic complexes and small fractions were observed to be exchangeable on a cation column.

Humic acid precipitates in sea-water and picks up in the process a variety of major and trace elements present in the medium. In the light of the above observations and the presence of high concentrations of Mg and Ca, other alkaline earth elements are not expected to be significantly picked up by the settling humic acid. Results presented in Table I also support this contention. However, it has been observed that Y is almost quantitatively picked up by the settling humic acid under similar conditions.[1]

TABLE I*

Pick-up of $^{85-89}Sr$ by humic acid (sea-water medium)

Time (days)	Activity in cpm per ml. in filtrate	
	Blank	Sample
0·17	1643	1633
7	1415	1370
16	1306	1293
22	1238	1230
33	1083	1074

* Humic acid sol. 12·8 mg. (exchange capacity 383 meq per 100 g.) in 100 ml $^{85-89}Sr$ (carrier content - 1·86 mg.), spiked sea water was left with intermittent shaking. Aliquots filtered from time to time, filtrate counts compared with that of the blank.

In this paper, further results are presented on the nature of this differential interaction of humic and fulvic acids with alkaline earth and rare earth elements. Discussions follow each of the experiments.

and performance of the precision instruments installed in Gauribidanur near Bangalore for the detection and supply of data on earthquakes and underground nuclear tests which may be carried out at any part of the world. Dr. R. Ramanna showed some slides of recent measurements carried out on skyscraper buildings in America to study the effects of underground nuclear explosions. Dr. S. K. Chakrabarty (Department of Applied Mathematics, University College of Science, Calcutta) spoke on "Theoretical Seismology" and Prof. V. R. Thiruvenkatachar on "Mathematical Models in Seismology".

The evening lecture was on "Modern Meteorology" by Miss Anna Mani (Deputy Director-General of Observatories, New Delhi) in which she dealt chiefly with satellite meteorology. The lecture concluded with a 15-minute film show of cloud photographs depicting 10 day, 5 day, and daily changes of cloud patterns over the globe, as transmitted by the meteorological satellites circling the earth.

The invited lecture on the morning of the fourth day was on "Molecular Structure" by Dr. C. N. R. Rao (Indian Institute of Technology, Kanpur). Dr. Rao in his lecture gave a clear exposition of our present state of knowledge on the structure of H_2O, the water molecule, as revealed by latest techniques by chemical, physical, and spectroscopic methods.

The topic for the group discussions for this day's afternoon session was "Plant Diseases". Eleven speakers presented their subjects each in a 15-minute talk followed by discussions. Prof. T. S. Sadasivan (Director, University Botany Laboratory, Madras), who chaired the meeting, in his introductory talk made special reference to experiments with isolated protoplasts. Dr. S. Suryanarayana (Department of Botany, University of Madras) spoke on "Environment and Disease"; Dr. R. Kalyanasundaram (University of Madras) on "Plant Immunity and Resistance"; Dr. D. Subramanian (Department of Botany, University of Madras) on "Phytoallergins"; and Dr. V. Agnihothrudu (Technical Adviser, Rallis India, Ltd.) on "Chemical Control of Fungal Diseases". These were followed by the Coimbatore Agricultural College Research group headed by Dr. K. Ramakrishnan who spoke on "General Virology", Dr. K. K. N. Nambiar on "Patho-physiology of Virus Diseases", Mr. A. Anjaneyulu on "Mycoplasma/PPLO-induced Pathogenesis in Plants", and Mr. T. K. Kandaswami on "Control of Virus Diseases". Finally, Dr. G. Rangaswami (Dean, University of Agricultural Sciences, Bangalore) spoke on "Bacteriology and Soil Microbiology", and Dr. S. Y. Padmanabhan (Director, Rice Research Institute, Cuttack) on "Breeding for Disease Resistance in Rice".

The evening lecture on the fourth day was delivered by Dr. R. M. Varma (Director, All-India Institute of Mental Health, Bangalore) on "Brain and Mind".

The proceedings of the fifth day of the session started with the lecture on "Radio Astronomy" by Dr Govind Swarup, (Radio Astronomy Division, TIFR, Ooty). The lecturer in his survey of the subject spoke on Radio-Sources, Moon's Occultation, Inter-planetary Medium, and Pulsars, and made special reference to the potentialities of the newly installed Radio Telescope at Ooty which has gone into action.

The group discussions in the afternoon was on "Aeronautics" in which four experts took part. Dr. V. M. Ghatage (General Manager, Hindustan Aeronautics Ltd., Bangalore) who chaired the meeting spoke on "Some Specific Problems in the Design of an Aircraft". Among the problems he discussed were Static Pressure Measurements, After Body Drag, and Interference. This was followed by a talk by Prof. Satish Dhawan (Director, Indian Institute of Science, Bangalore) on "Breakdown of Laminar Motion". Prof. R. Narasimha (Indian Institute of Science, Bangalore) spoke on "Shock Wave Structure". The last speaker was Dr. S. R. Valluri (Director, National Aeronautical Laboratory, Bangalore) who spoke on "Some Aspects of Fatigue Failure".

The evening lecture of the day was on "Our Mineral Resources" by Dr. B. P. Radhakrishna (Director, Department of Mines and Geology, Bangalore).

On the sixth and last day of the meeting the morning invited lecture was given under the Chairmanship of Dr. S. Dhawan, by Dr. S. Ramaseshan (National Aeronautical Laboratory, Bangalore) on "Materials Science". The lecturer reviewed the current progress in the field of Stress/Strain relations in alloys and composite materials, and discussed the problems his group is tackling at the NAL on fibre reinforcement technique and the new technique of electrolytic deposition of thin layers in matrix materials. At his request his collaborator Mr. Rangarajan supplemented the lecture

by a short talk on the mathematics involved in the above technique.

The afternoon group discussions were on "The Structure of the Galaxy" in which the following specialists spoke on the subject mentioned against each: Dr. K. D. Abhyanker (Nizam's Observatory, Hyderabad) on "Kinematical Features of the Galaxy"; Dr. J. C. Bhattacharyya (Kodaikanal Observatory) on "Brightness Distribution of the Milky Way in the UV, Visual and Infrared Regions"; Dr. G. Swarup on "Radio Continuum and Line Radiation Characteristic of the Galaxy"; Dr. M. K. Vainu Bappu on "Optical Aspects of Spiral Structure of the Galaxy"; Mr. Ch. V. Sastry on "Low Frequency Detection of Ionized Hydrogen Regions"; Dr. B. V. Sreekantan (Tata Institute of Fundamental Research, Bombay) on "Gamma-rays, X-rays and the Galaxy"; and Dr. R. R. Daniel (TIFR, Bombay) on "Cosmic Rays and the Structure of the Galaxy".

The evening lecture was given by Dr. V. Prabhakar Rao (Entomologist-in-Charge, Commonwealth Institute of Biological Control, Bangalore) on "Insect Control".

The Session concluded with an expression of thanks by the President Sir C. V. Raman, to all the Fellows, Invitees and Delegates who by making this "contact of minds" possible contributed to the success of the meeting.

DIFFERENTIAL INTERACTION OF MARINE HUMIC AND FULVIC ACIDS WITH ALKALINE EARTH AND RARE EARTH ELEMENTS

M. V. M. DESAI, ELIZABETH MATHEW AND A. K. GANGULY
Health Physics Division, Bhabha Atomic Research Centre, Trombay, Bombay-85, India

ABSTRACT

Alkaline earth sulphates such as of Ba and Ra and rare earth hydroxides such as of Y, La and Ac were solubilized significantly by marine humic and fulvic acids in ammoniacal medium. Alkaline earth elements were associated with humic and fulvic acids as exchangeable cationic and/or cationic complexes whereas rare earth elements formed non-cationic complexes. Major fraction of humic acid precipitates in sea-water and this settling humic acid picks up only rare earth elements from alkaline earth-rare earth radioactive pairs. These rare earths were associated with humic acid as non-cationic complexes. The dissolved fraction of humic acid in sea-water also had the rare earths in non-cationic complex forms.

INTRODUCTION

HUMIC ACID (in ammoniacal medium) solubilizes a large number of elements.[1] Solubilized Ba was found to be associated with the cation exchange sites of humic acid and the total solubilization of $BaSO_4$ was observed to be equivalent to the exchange capacity.[1] Solubilized transition and trivalent elements such as Zn, Mn, Cu, Co, Fe and Y are bound with the humic acid mostly as non-cationic complexes and small fractions were observed to be exchangeable on a cation column.

Humic acid precipitates in sea-water and picks up in the process a variety of major and trace elements present in the medium. In the light of the above observations and the presence of high concentrations of Mg and Ca, other alkaline earth elements are not expected to be significantly picked up by the settling humic acid. Results presented in Table I also support this contention. However, it has been observed that Y is almost quantitatively picked up by the settling humic acid under similar conditions.[1]

TABLE I*

Pick-up of $^{85-89}Sr$ by humic acid (sea-water medium)

Time (days)	Activity in cpm per ml. in filtrate	
	Blank	Sample
0·17	1643	1633
7	1415	1370
15	1306	1293
22	1238	1230
33	1083	1071

* Humic acid sol. 12·8 mg. (exchange capacity 383 meq per 100 g.) in 100 ml $^{85-89}Sr$ (carrier content 1·86 mg.), spiked sea water was left with intermittent shaking. Aliquots filtered from time to time, filtrate counts compared with that of the blank.

In this paper, further results are presented on the nature of this differential interaction of humic and fulvic acids with alkaline earth and rare earth elements. Discussions follow each of the experiments.

MATERIALS

The tracer experiments were carried out using the radioactive pairs ^{90}Sr–^{90}Y, ^{140}Ba–^{140}La and ^{228}Ra–^{228}Ac. Humic and fulvic acids were prepared by alkaline extraction of a sample each of coastal marine sediment (CS) and shelf sediment I* (SSI) by the procedure as described in References 2, 3 and 4. Filtered† stock solutions had 0·95 mg. per ml. of humic acid and 0·11 mg. per ml. of fulvic acid. Interactions were studied in two media, *viz.*, ammoniacal and sea-water.

EXPERIMENTS AND DISCUSSIONS

Ammoniacal medium (in situ *precipitates*)

Experiment.—Two ml. of ammonia (6 N) and 1 ml. of 2% $(NH_4)_2SO_4$ were added to 1 ml. samples of humic (CS) and fulvic (SSI) acids. A known volume of the radioactive pairs containing known amounts of the inactive carriers of the elements was added to these solutions and to blanks. Volumes were made up to 5 ml. with distilled water and kept for a week with intermittent shaking, filtered and 1 ml. *filtrates* were counted for beta activity. One ml. aliquots were passed (0·2 ml. per min.) through Dowex 50 W X-8 cation column (2 cm. × 1 cm.) conditioned to NH_4^+ form with 2·5 N ammonia. The column was washed with 2 column volumes of 2·5 N ammonia. *Effluents and washings* were evaporated and counted.

The activity retained in the column was eluted in each case with five column volumes of 4 M HNO_3, the *eluate* evaporated and counted. The count rates of effluents and eluates were followed for decay and build-up. Results are given in Tables II and III, and in Figs. 1, 2, 3, 4 and 5.

Discussion.—The experimental procedures were such that Ba and Ra would have precipitated as sulphates and Y and La as hydroxides both from blank and sample solutions in the absence of solubilization. In the filtrate counts it is to be observed that whereas humic and fulvic acids solubilize all the ionic species, there is considerable depletion in the filtrate counts in the blank indicating the precipitation. The dissolved (solubilized) trace elements in blank are observed to be practically quantitatively retained on cation column (*cf.* Tables II and III). The effluents of humic and fulvic acids decayed with 64, 40 and 6 hours half-lives respectively of ^{90}Y, ^{140}La and ^{228}Ac. The eluates from the respective columns built up to saturation activities with time at rates required of ^{90}Sr, ^{140}Ba and ^{228}Ra. Thus, the effluents containing ^{90}Y, ^{140}La and ^{228}Ac were present as non-cationic complexes. And the Ba and Ra were associated with humic and fulvic acids in exchangeable cationic forms (*cf.* Figs. 1, 2, 3, 4 and 5).

TABLE II

Interaction of humic acid with alkaline earth and rare earth elements (ammoniacal medium)

Activity in cpm per ml.

	^{90}Sr–^{90}Y		^{140}Ba–^{140}La		^{228}Ra	^{228}Ac
	Blank	Humic acid	Blank	Humic acid	Blank	Humic acid
Added ..	7244 (2 μg. Sr, 1 μg. Y)	7244 (2 μg. Sr, 1 μg. Y)	8300 (2 μg. Ba, 1 μg. La)	8300 (2 μg. Ba, 1 μg. La)	223 (2 μg. Ba)	223 (2 μg. Ba)
Filtrate ..	3568	7293	96	2264	67	197
Influent ..	3568	7293	96	2264	67	197
*Effluent and washings	14	3608	6	1094	Nil	138
*Eluate ..	..	2164	..	671	..	60

* *See* Figs. 1, 2 and 3 for decay and build up.

TABLE III

Interaction of fulvic acid with alkaline earth and rare earth elements (ammoniacal medium)

Activity in cpm per ml.

	^{90}Sr–^{90}Y		^{140}Ba–^{140}La	
	Blank	Fulvic acid	Blank	Fulvic acid
Added ..	7244 (2 μg. Sr, 1 μg. Y)	1448 (0·8 μg. Sr, 0·4 μg. Y)	8300 (2 μg. Ba, 1 μg. La)	4150 (1 μg. Ba, 0·5 μg. La)
Filtrate ..	3568	1406	96	329
Influent ..	3569	1406	96	329
*Effluent and washings	14	414	6	201
*Eluate ..	..	257	..	180

* *See* Figs. 4 and 5 for decay and build up.

Humic and fulvic acids are not only solubilizing agents, but there are selective interactions for the two groups—alkaline earths and rare earths. Pillai *et al.*'s[3] finding that Ca was not detected in the ash of drastically electrodialysed humic acid is also in line with the present observation. However, the sorption of trivalent elements in exchangeable form is not completely excluded, since Pillai *et al.*[3] also observed that a mixture of humic and fulvic acids purified by simple dialysis and filtered has about 10% of its Fe^{+3} content as exchangeable on cation column.

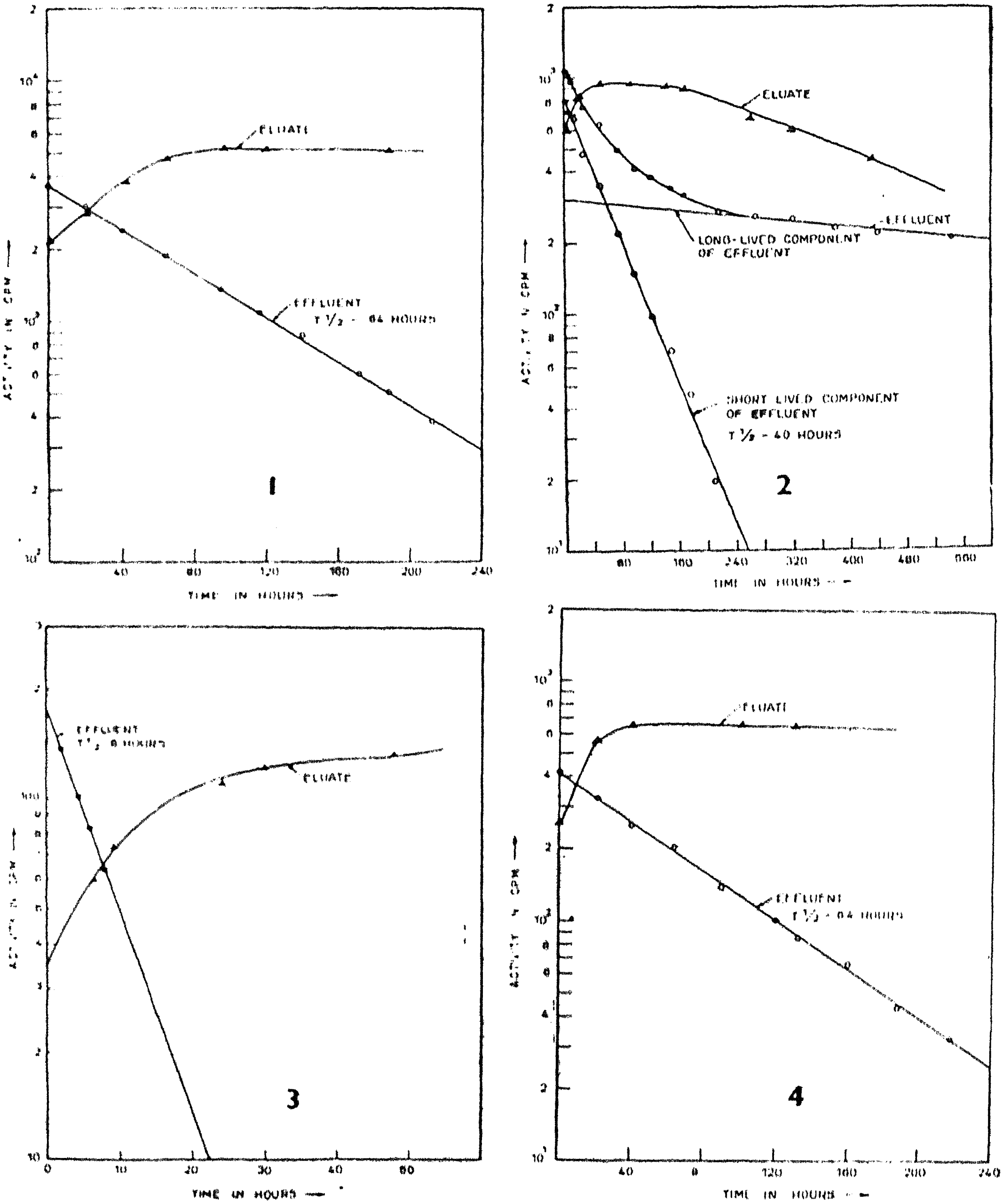
---

* 21 miles off-shore (at 50 m. depth).

† All filtrations in the work were made through 0·22 μ Millipore membrane.

Sea-Water Medium.

Experiment. Humic acid (CS) adjusted pH 7·9 by NaOH and filtered was used.



FIGS. 1–4. Fig. 1. Interaction of humic acid with ^{90}Sr–^{90}Y (Ammoniacal medium). Fig. 2.* Interaction of humic acid with ^{140}Ba–^{140}La (Ammoniacal medium). Fig. 3. Interaction of humic acid with ^{228}Ra–^{228}Ac (Ammoniacal medium). Fig. 4. Interaction of fulvic acid with ^{90}Sr–^{90}Y (Ammoniacal medium).

* Prepared from fission products having a trace of long lived component as a contaminant. The decay curve for the short-lived component has been obtained after subtracting from the total counts of the effluent the corresponding extrapolated counts of the long-lived component.

MATERIALS

The tracer experiments were carried out using the radioactive pairs ^{90}Sr–^{90}Y, ^{140}Ba–^{140}La and ^{228}Ra–^{228}Ac. Humic and fulvic acids were prepared by alkaline extraction of a sample each of coastal marine sediment (CS) and shelf sediment I[*] (SSI) by the procedure as described in References 2, 3 and 4. Filtered[†] stock solutions had 0·95 mg. per ml. of humic acid and 0·11 mg. per ml. of fulvic acid. Interactions were studied in two media, *viz.*, ammoniacal and sea-water.

EXPERIMENTS AND DISCUSSIONS

Ammoniacal medium (in situ *precipitates*)

Experiment.—Two ml. of ammonia (6 N) and 1 ml. of 2% $(NH_4)_2SO_4$ were added to 1 ml. samples of humic (CS) and fulvic (SSI) acids. A known volume of the radioactive pairs containing known amounts of the inactive carriers of the elements was added to these solutions and to blanks. Volumes were made up to 5 ml. with distilled water and kept for a week with intermittent shaking, filtered and 1 ml. *filtrates* were counted for beta activity. One ml. aliquots were passed (0·2 ml. per min.) through Dowex 50 W X-8 cation column (2 cm. × 1 cm.) conditioned to NH_4^+ form with 2·5 N ammonia. The column was washed with 2 column volumes of 2·5 N ammonia. *Effluents and washings* were evaporated and counted.

The activity retained in the column was eluted in each case with five column volumes of 4 M HNO_3, the *eluate* evaporated and counted. The count rates of effluents and eluates were followed for decay and build-up. Results are given in Tables II and III, and in Figs. 1, 2, 3, 4 and 5.

TABLE II

Interaction of humic acid with alkaline earth and rare earth elements (ammoniacal medium)

	Activity in cpm per ml.					
	^{90}Sr – ^{90}Y		^{140}Ba – ^{140}La		^{228}Ra	^{228}Ac
	Blank	Humic acid	Blank	Humic acid	Blank	Humic acid
Added ..	7244 (2 μg. Sr, 1 μg. Y)	7244 (2 μg. Sr, 1 μg. Y)	8300 (2 μg. Ba, 1 μg. La)	8300 (2 μg. Ba, 1 μg. La)	223 (2 μg. Ba)	223 (2 μg. Ba)
Filtrate ..	3568	7293	96	2264	67	197
Influent ..	3568	7293	96	2264	67	197
*Effluent and washings	14	3508	6	1094	Nil	138
*Eluate ..	..	2164	..	671	..	60

* *See* Figs. 1, 2 and 3 for decay and build up.

TABLE III

Interaction of fulvic acid with alkaline earth and rare earth elements (ammoniacal medium)

	Activity in cpm per ml.			
	^{90}Sr – ^{90}Y		^{140}Ba ^{140}La	
	Blank	Fulvic acid	Blank	Fulvic acid
Added ..	7244 (2 μg. Sr, 1 μg. Y)	1448 (0·8 μg. Sr, 0·4 μg. Y)	8300 (2 μg. Ba, 1 μg. La)	4150 (1 μg. Ba, 0·5 μg. La)
Filtrate ..	3568	1406	96	329
Influent ..	3569	1406	96	329
*Effluent and washings	14	414	6	201
*Eluate ..	..	257	..	180

* *See* Figs. 4 and 5 for decay and build up.

Discussion.—The experimental procedures were such that Ba and Ra would have precipitated as sulphates and Y and La as hydroxides both from blank and sample solutions in the absence of solubilization. In the filtrate counts it is to be observed that whereas humic and fulvic acids solubilize all the ionic species, there is considerable depletion in the filtrate counts in the blank indicating the precipitation. The dissolved (solubilized) trace elements in blank are observed to be practically quantitatively retained on cation column (*cf.* Tables II and III). The effluents of humic and fulvic acids decayed with 64, 40 and 6 hours half-lives respectively of ^{90}Y, ^{140}La and ^{228}Ac. The eluates from the respective columns built up to saturation activities with time at rates required of ^{90}Sr, ^{140}Ba and ^{228}Ra. Thus, the effluents containing ^{90}Y, ^{140}La and ^{228}Ac were present as non-cationic complexes. And the Ba and Ra were associated with humic and fulvic acids in exchangeable cationic forms (*cf.* Figs. 1, 2, 3, 4 and 5).

Humic and fulvic acids are not only solubilizing agents, but there are selective interactions for the two groups: alkaline earths and rare earths. Pillai *et al.*'s[3] finding that Ca was not detected in the ash of drastically electrodialysed humic acid is also in line with the present observation. However, the sorption of trivalent elements in exchangeable form is not completely excluded, since Pillai *et al.*[3] also observed that a mixture of humic and fulvic acids purified by simple dialysis and filtered has about 10% of its Fe^{+3} content as exchangeable on cation column.

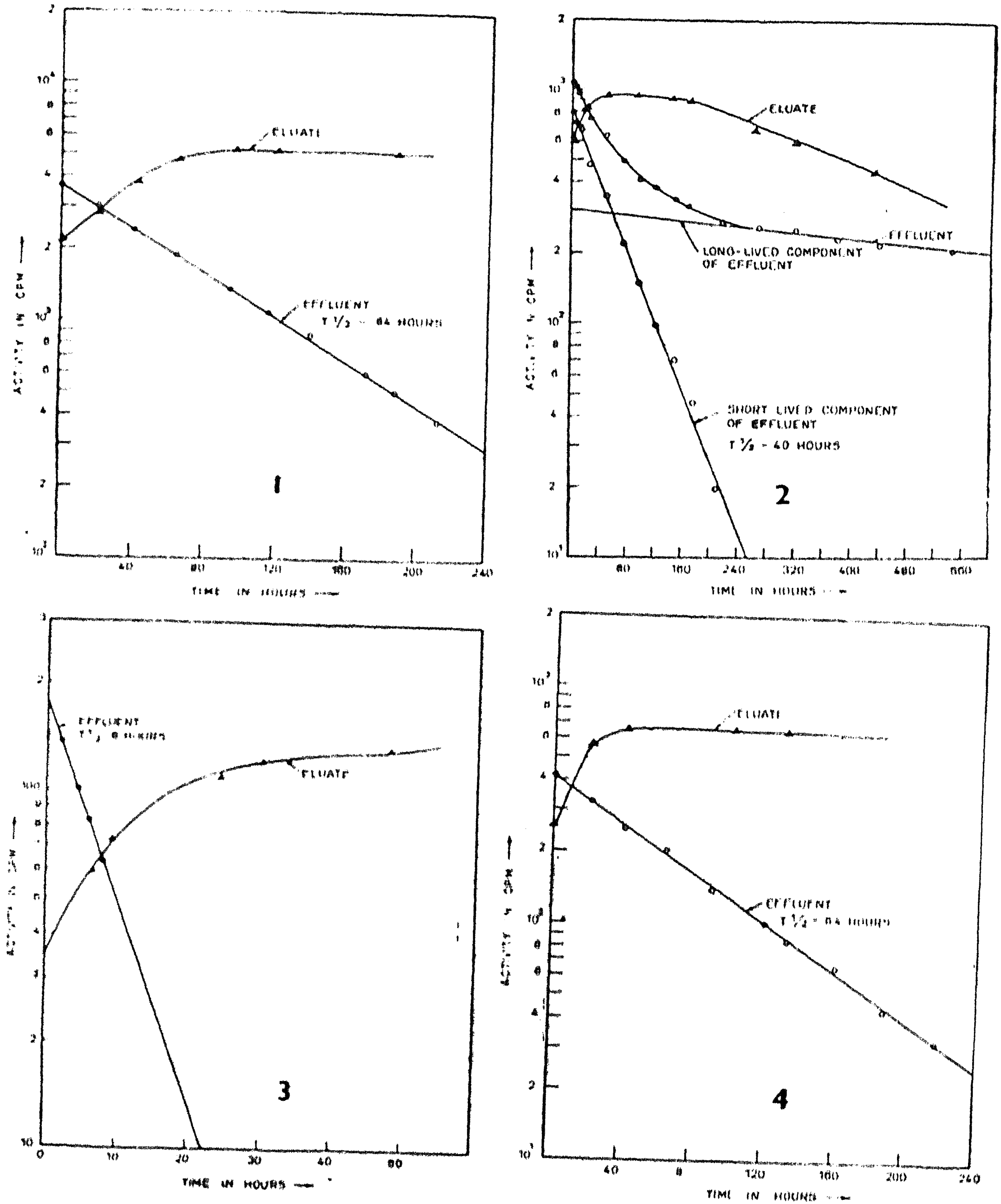
---

[*] 21 miles off-shore (at 50 m. depth).

[†] All filtrations in the work were made through 0·22 μ Millipore membrane.

Sea-Water Medium.

Experiment. Humic acid (CS) adjusted to pH 7·9 by NaOH and filtered was used.



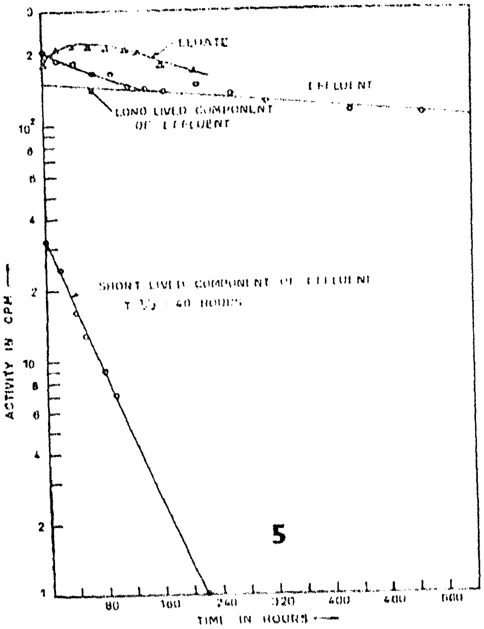
FIGS. 1–4. Fig. 1. Interaction of humic acid with ^{90}Sr–^{90}Y (Ammoniacal medium). Fig. 2.* Interaction of humic acid with ^{140}Ba–^{140}La (Ammoniacal medium). Fig. 3. Interaction of humic acid with ^{228}Ra–^{228}Ac (Ammoniacal medium). Fig. 4. Interaction of fulvic acid with ^{90}Sr–^{90}Y (Ammoniacal medium).

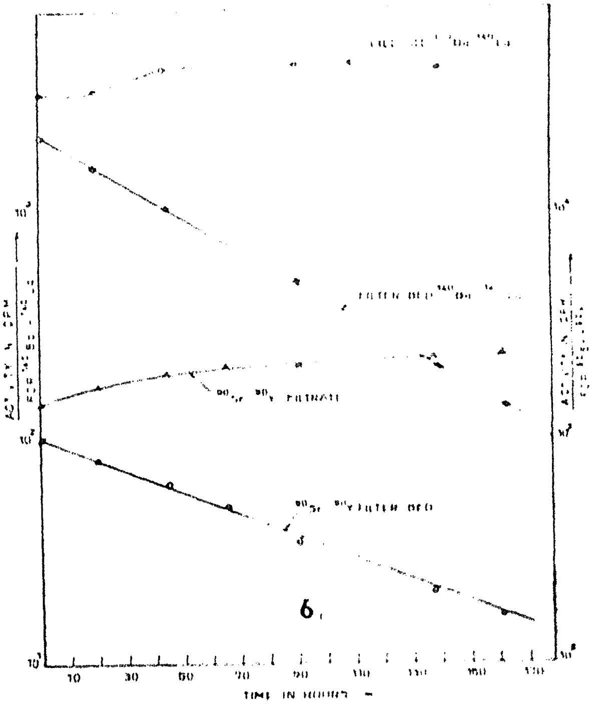
* Prepared from fission products having a trace of long lived component as a contaminant. The decay curve for the short-lived component has been obtained after subtracting from the total counts of the effluent the corresponding extrapolated counts of the long-lived component.

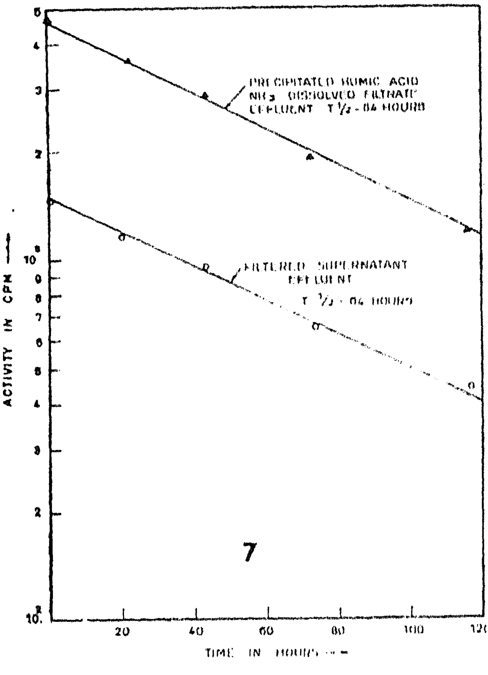
The following solutions:

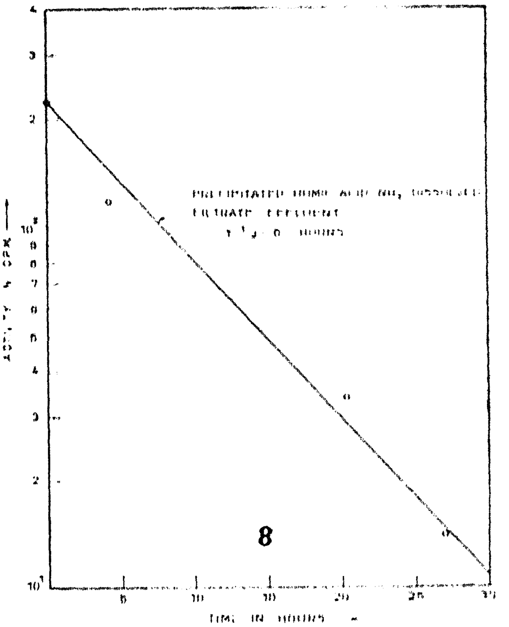
Blank: 90 ml. filtered sea-water + 5 ml. filtered double concentrated sea-water + 5 ml. double-distilled water + ^{90}Sr–^{90}Y or ^{140}Ba–^{140}La and

Sample: 90 ml. filtered sea-water + 5 ml. filtered double-concentrated sea-water + 5 ml. humic acid + ^{90}Sr–^{90}Y or ^{140}Ba–^{140}La were kept for a week with intermittent shaking. Two ml. of well-mixed aliquots









FIGS. 5–8. Fig. 5 * Interaction of fulvic acid with ^{140}Ba–^{140}La (Ammoniacal medium). Fig. 6. Interaction of humic acid with ^{140}Ba–^{140}La and ^{90}Sr–^{90}Y (Sea-water medium). Fig. 7. Interaction of humic acid with ^{90}Sr–^{90}Y (Sea-water medium). Fig. 8. Interaction of humic acid with ^{228}Ra–^{228}Ac (Sea-water medium).

* See the comments in Fig. 2.

of each were filtered, the *filter-beds* and the *filtrates* were counted for beta activity – the decay and build-up were followed. The filter-bed activity of the control was subtracted from that of the sample filter-bed and the resulting values are plotted in Fig. 6.

Discussion.—Figure 6 shows that activities retained on the filter-beds decayed with the half-lives of ^{90}Y and ^{140}La. The sample filtrate activity showed build-up, reaching saturation activities at the expected rates. The decay curves for ^{90}Y and ^{140}La also show the radiochemical purity of the picked up Y and La.

Experiment.—To re-examine the state of combination of the elements in the precipitated humic acid, the precipitates obtained in another set of experiments in sea-water medium with ^{90}Sr-^{90}Y and ^{228}Ra-^{228}Ac were centrifuged, the supernatant and the residue separated.

The residue was dissolved in 2 ml. of ammonia (6 N), diluted to 5 ml. with distilled water, centrifuged and filtered. One ml. *filtrate* was counted and another 1 ml. aliquot was passed through a cation column conditioned to NH_4^+ form as before and the *effluents and washings* were counted. The column was eluted with 4 M HNO_3-*eluate*, evaporated and counted. Results are given in Table IV and Figs. 7 and 8.

Discussion.—It is to be observed that the activity picked up by the precipitated humic acid decays with the half-lives of rare earths. The same decay characteristic is observed with the effluents and washings confirming the earlier observations (with solubilized fraction) with the trivalent elements associated with humic acid as non-cationic complexes. The eluates gave very few counts with a tendency to build up at the rate of corresponding alkaline earth. This is ascribed only to the alkaline earth contamination remaining with the residue on centrifugation rather than any definite pick-up by the precipitate. We may conclude then that the complexed ^{90}Y and ^{228}Ac are in similar states of combination both in the solubilized and the precipitated state of humic acid.

Experiment.—It has been observed earlier[3] that there is always a dissolved fraction of humic acid present in the sea-water filtrate. Eighty-five per cent of the dissolved fraction was found to be precipitable in the acid and this has the same characteristic UV absorption spectrum of the original humic acid. The balance 15% that does not precipitate out has an absorption spectrum similar to fulvic acid. It has been observed that the solubility of the separated humic acid in sea-water ranges from 75 to 100 μg. per ml. And in earlier experiments it was observed that Fe was significantly solubilized by this dissolved fraction.[2] To examine the possible similarity of interaction with Y and Ac, the *filtered supernatants* (in sea-water) were passed through cation columns conditioned to Na^+ form by 3·5% NaCl. The *effluents and washings* were counted and followed for decay. Results are presented in Figs. 7 and 8.

TABLE IV

Interaction of humic acid with alkaline earth and rare earth elements (sea-water medium)

	Activity in cpm per ml.					
	^{90}Sr-^{90}Y			^{228}Ra-^{228}Ac		
	Blank	Humic acid	Pptd HA in NH_3†	Blank	Humic acid	Pptd HA in NH_3†
Added ..	19047	19047	..	920	920	..
Filtrate ..	15100	9591	..	526	197	..
Influent ..	15100	9591	5620	526	197	270
*Effluent and washings	216	1464	4707	Nil	70	221
*Eluate ..	..	755	24	..	..	13

* *See* Figs. 7 and 8 for decay. † This is humic acid that precipitated in sea-water picking up the elements and was dissolved in NH_3 and filtered.

Discussion.—It is to be observed that ^{90}Y and ^{228}Ac pass through the column whereas the same activities of the blank solutions were quantitatively retained. The state of combination of the rare earth elements with humic and fulvic acids in dissolved state—in the ammoniacal medium or in the sea-water medium—and also in the precipitated state are the same, *viz.*, the non-cationic complex. The same statement would apply to trivalent elements such as Fe, Al, etc.

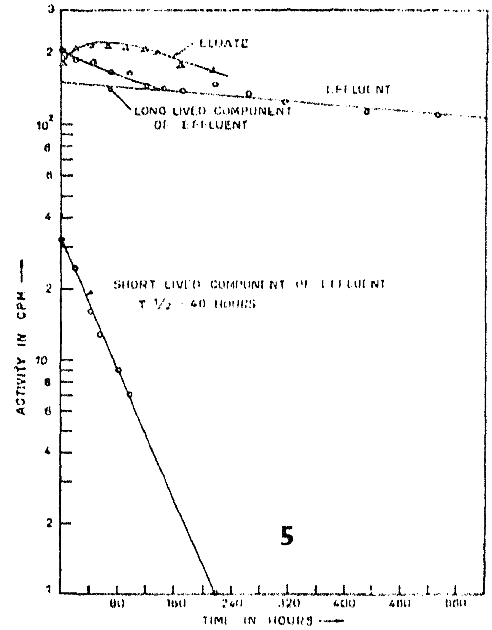
---

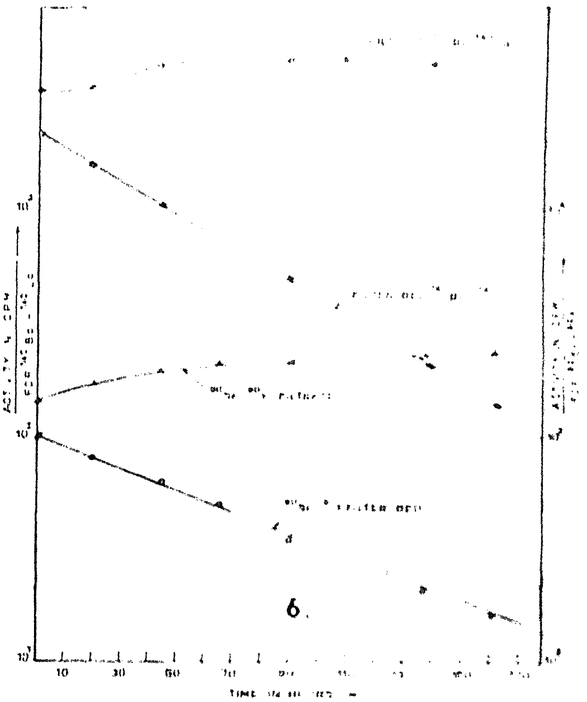
1. Koshy, E., Desai, M. V. M. and Ganguly, A. K., *Curr. Sci.*, 1969, **38**, 582.
2. — and Ganguly, A. K., *BARC-402*, 1969.
3. Pillai *et al.*, 1970 (Unpublished work).
4. Desai, M. V. M. and Ganguly, A. K., 1970 (Under publication).

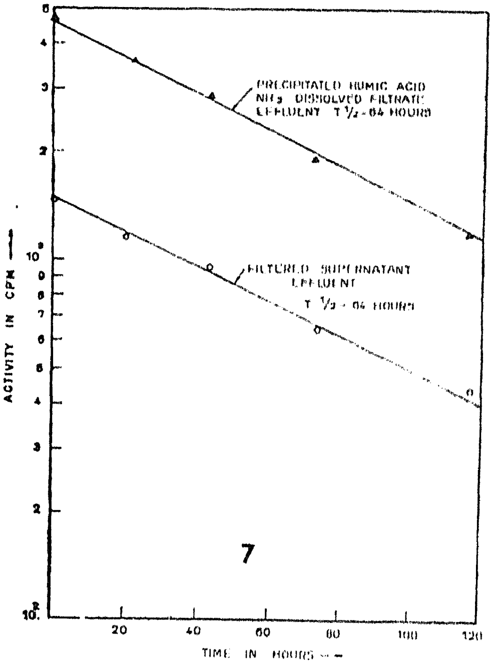
The following solutions:

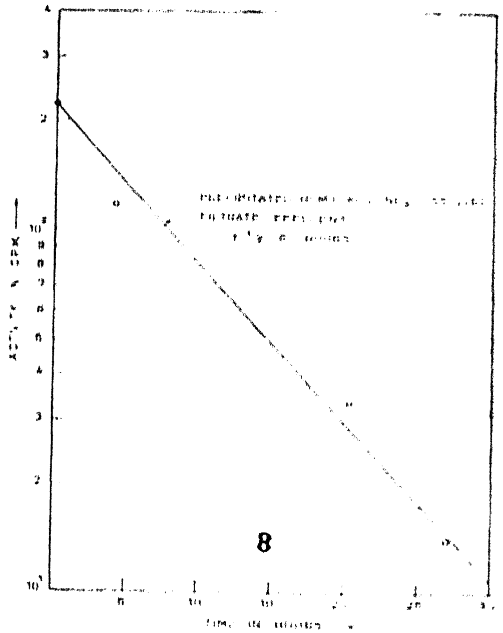
Blank: 90 ml. filtered sea-water + 5 ml. filtered double concentrated sea-water + 5 ml. double-distilled water + $^{90}Sr-^{90}Y$ or $^{140}Ba-^{140}La$ and

Sample: 90 ml. filtered sea-water + 5 ml. filtered double concentrated sea-water + 5 ml. humic acid + $^{90}Sr-^{90}Y$ or $^{140}Ba-^{140}La$ were kept for a week with intermittent shaking. Two ml. of well mixed aliquots









FIGS. 5–8. Fig. 5 * Interaction of fulvic acid with $^{140}Ba-^{140}La$ (Ammoniacal medium). Fig. 6. Interaction of humic acid with $^{140}Ba-^{140}La$ and $^{90}Sr-^{90}Y$ (Sea-water medium). Fig. 7. Interaction of humic acid with $^{90}Sr-^{90}Y$ (Sea-water medium). Fig. 8. Interaction of humic acid with $^{228}Ra-^{228}Ac$ (Sea water medium).

* See the comments in Fig. 2.

of each were filtered, the *filter-beds* and the *filtrates* were counted for beta activity the decay and build-up were followed. The filter-bed activity of the control was subtracted from that of the sample filter-bed and the resulting values are plotted in Fig. 6.

Discussion. Figure 6 shows that activities retained on the filter-beds decayed with the half-lives of ^{90}Y and ^{140}La. The sample filtrate activity showed build-up, reaching saturation activities at the expected rates. The decay curves for ^{90}Y and ^{140}La also show the radiochemical purity of the picked up Y and La.

Experiment. To re-examine the state of combination of the elements in the precipitated humic acid, the precipitates obtained in another set of experiments in sea-water medium with ^{90}Sr-^{90}Y and ^{228}Ra-^{228}Ac were centrifuged, the supernatant and the residue separated.

The residue was dissolved in 2 ml. of ammonia (6 N), diluted to 5 ml. with distilled water, centrifuged and filtered. One ml. *filtrate* was counted and another 1 ml. aliquot was passed through a cation column conditioned to NH_4^+ form as before and the *effluents and washings* were counted. The column was eluted with 4 M HNO_3-*eluate*, evaporated and counted. Results are given in Table IV and Figs. 7 and 8.

Discussion.—It is to be observed that the activity picked up by the precipitated humic acid decays with the half-lives of rare earths. The same decay characteristic is observed with the effluents and washings confirming the earlier observations (with solubilized fraction) with the trivalent elements associated with humic acid as non-cationic complexes. The eluates gave very few counts with a tendency to build up at the rate of corresponding alkaline earth. This is ascribed only to the alkaline earth contamination remaining with the residue on centrifugation rather than any definite pick-up by the precipitate. We may conclude then that the complexed ^{90}Y and ^{228}Ac are in similar states of combination both in the solubilized and the precipitated state of humic acid.

Experiment.—It has been observed earlier[2] that there is always a dissolved fraction of humic acid present in the sea-water filtrate. Eighty-five per cent. of the dissolved fraction was found to be precipitable in the acid and this has the same characteristic UV absorption spectrum of the original humic acid. The balance 15% that does not precipitate out has an absorption spectrum similar to fulvic acid. It has been observed that the solubility of the separated humic acid in sea-water ranges from 75 to 100 μg. per ml. And in earlier experiments it was observed that Fe was significantly solubilized by this dissolved fraction.[2] To examine the possible similarity of interaction with Y and Ac, the *filtered supernatants* (in sea-water) were passed through cation columns conditioned to Na^+ form by 3·5% NaCl. The *effluents and washings* were counted and followed for decay. Results are presented in Figs. 7 and 8.

TABLE IV

Interaction of humic acid with alkaline earth and rare earth elements (sea-water medium)

	Activity in cpm per ml.					
	^{90}Sr–^{90}Y			^{228}Ra–^{228}Ac		
	Blank	Humic acid	Pptd. HA in NH_3†	Blank	Humic acid	Pptd. HA in NH_3†
Added ..	19047	19047	..	929	929	..
Filtrate ..	15100	9591	..	526	197	..
Influent ..	15100	9591	5620	626	197	270
*Effluent and washings	216	1464	4707	Nil	70	221
*Eluate ..	..	755	24	..	..	13

* *See* Figs. 7 and 8 for decay. † This is humic acid that precipitated in sea water picking up the elements and was dissolved in NH_3 and filtered.

Discussion.—It is to be observed that ^{90}Y and ^{228}Ac pass through the column whereas the same activities of the blank solutions were quantitatively retained. The state of combination of the rare earth elements with humic and fulvic acids in dissolved state in the ammoniacal medium or in the sea-water medium and also in the precipitated state are the same, *viz.*, the non-cationic complex. The same statement would apply to trivalent elements such as Fe, Al, etc.

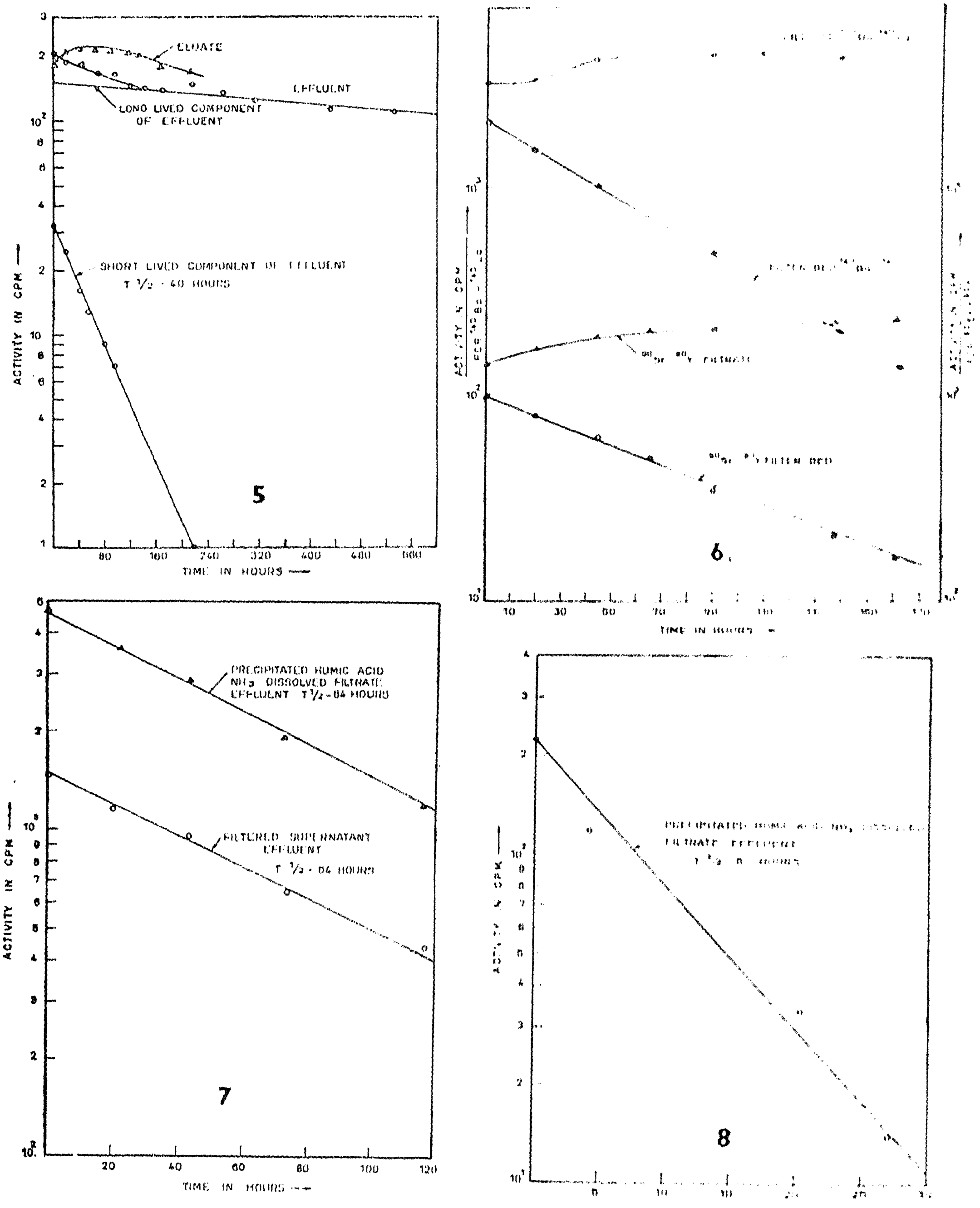
---

1. Koshy, E., Desai, M. V. M. and Ganguly, A. K., *Curr. Sci.*, 1969, **38**, 582.
2. — and Ganguly, A. K., *BARC-402*, 1969.
3. Pillai *et al.*, 1970 (Unpublished work).
4. Desai, M. V. M. and Ganguly, A. K., 1970 (Under publication).

The following solutions:

Blank: 90 ml. filtered sea-water + 5 ml. filtered double concentrated sea-water + 5 ml. double-distilled water +^{90}Sr-^{90}Y or ^{140}Ba-^{140}La and

Sample: 90 ml. filtered sea-water + 5 ml. filtered double-concentrated sea-water + 5 ml. humic acid + ^{90}Sr-^{90}Y or ^{140}Ba-^{140}La were kept for a week with intermittent shaking. Two ml. of well-mixed aliquots



FIGS. 5–8. Fig. 5 * Interaction of fulvic acid with ^{140}Ba-^{140}La (Ammoniacal medium). Fig. 6. Interaction of humic acid with ^{140}Ba-^{140}La and ^{90}Sr-^{90}Y (Sea-water medium). Fig. 7. Interaction of humic acid with ^{90}Sr-^{90}Y (Sea-water medium). Fig. 8. Interaction of humic acid with ^{228}Ra-^{228}Ac (Sea water medium).

* See the comments in Fig. 2.

of each were filtered, the *filter-beds* and the *filtrates* were counted for beta activity the decay and build-up were followed. The filter-bed activity of the control was subtracted from that of the sample filter-bed and the resulting values are plotted in Fig. 6.

Discussion. Figure 6 shows that activities retained on the filter-beds decayed with the half-lives of ^{90}Y and ^{140}La. The sample filtrate activity showed build-up, reaching saturation activities at the expected rates. The decay curves for ^{90}Y and ^{140}La also show the radiochemical purity of the picked up Y and La.

Experiment. To re-examine the state of combination of the elements in the precipitated humic acid, the precipitates obtained in another set of experiments in sea-water medium with ^{90}Sr-^{90}Y and ^{228}Ra-^{228}Ac were centrifuged, the supernatant and the residue separated.

The residue was dissolved in 2 ml. of ammonia (6 N), diluted to 5 ml. with distilled water, centrifuged and filtered. One ml. *filtrate* was counted and another 1 ml. aliquot was passed through a cation column conditioned to NH_4^+ form as before and the *effluents and washings* were counted. The column was eluted with 4 M HNO_3-*eluate*, evaporated and counted. Results are given in Table IV and Figs. 7 and 8.

Discussion.—It is to be observed that the activity picked up by the precipitated humic acid decays with the half-lives of rare earths. The same decay characteristic is observed with the effluents and washings confirming the earlier observations (with solubilized fraction) with the trivalent elements associated with humic acid as non-cationic complexes. The eluates gave very few counts with a tendency to build up at the rate of corresponding alkaline earth. This is ascribed only to the alkaline earth contamination remaining with the residue on centrifugation rather than any definite pick-up by the precipitate. We may conclude then that the complexed ^{90}Y and ^{228}Ac are in similar states of combination both in the solubilized and the precipitated state of humic acid.

Experiment.—It has been observed earlier[2] that there is always a dissolved fraction of humic acid present in the sea-water filtrate. Eighty-five per cent. of the dissolved fraction was found to be precipitable in the acid and this has the same characteristic UV absorption spectrum of the original humic acid. The balance 15% that does not precipitate out has an absorption spectrum similar to fulvic acid. It has been observed that the solubility of the separated humic acid in sea-water ranges from 75 to 100 μg. per ml. And in earlier experiments it was observed that Fe was significantly solubilized by this dissolved fraction.[2] To examine the possible similarity of interaction with Y and Ac, the *filtered supernatants* (in sea-water) were passed through cation columns conditioned to Na^+ form by 3·5% NaCl. The *effluents and washings* were counted and followed for decay. Results are presented in Figs. 7 and 8.

TABLE IV

Interaction of humic acid with alkaline earth and rare earth elements (sea-water medium)

	Activity in cpm per ml.					
	^{90}Sr - ^{90}Y			^{228}Ra - ^{228}Ac		
	Blank	Humic acid	Ppted. HA in NH₃†	Blank	Humic acid	Ppted. HA in NH₃†
Added ..	19047	19047	..	929	929	..
Filtrate ..	15100	9591	..	526	197	..
Influent ..	15100	9591	5620	526	197	270
*Effluent and washings	216	1464	4707	Nil	70	221
*Eluate ..	..	755	24	..	..	13

* *See* Figs. 7 and 8 for decay. † This is humic acid that precipitated in sea water picking up the elements and was dissolved in NH_3 and filtered.

Discussion. It is to be observed that ^{90}Y and ^{228}Ac pass through the column whereas the same activities of the blank solutions were quantitatively retained. The state of combination of the rare earth elements with humic and fulvic acids in dissolved state in the ammoniacal medium or in the sea-water medium and also in the precipitated state are the same, *viz.*, the non-cationic complex. The same statement would apply to trivalent elements such as Fe, Al, etc.

---

1. Koshy, E., Desai, M. V. M. and Ganguly, A. K., *Curr. Sci.*, 1969, **38**, 582.
2. — and Ganguly, A. K., *BARC-402*, 1969.
3. Pillai *et al.*, 1970 (Unpublished work).
4. Desai, M. V. M. and Ganguly, A. K., 1970 (Under publication).

BREVIMYCINS, A NEW GROUP OF ANTIBIOTIC SUBSTANCES FROM A *BREVIBACTERIUM* SP. ISOLATE

K. KASTURI AND D. V. TAMHANE
Department of Chemical Technology, University of Bombay, Bombay-19

ANTIBIOTICS have now been isolated from a variety of fungi, streptomycetes, algæ, bacteria and lichens.[1-3] They vary widely in their spectrum of activity and chemical nature. Although nearly 1,100 antibiotic substances are discovered, only 66 have attained the level of commercial application.[4] Certain antibiotics, especially those of bacterial origin, are now gaining importance due to lack of resistance to them by the susceptible organisms.

Of the bacterial species, the organisms belonging to the genera *Bacillus*, *Clostridium* and *Pseudomonas* are of added interest due to the wide variety of antibiotics produced by them, as well as, the variety of antibiotics produced by the same species. Quite a few organisms belonging to other genera have also been attributed with the capacity for antibiotic production.[1]

While studying soil samples from oil-bearing areas, by using the dilution plate technique, a few isolates showing characteristic antagonism to others in their vicinity were encountered.[5] One of these isolates, which showed promising activity, was taken up for detailed study. This isolate, a gram-positive bacterium, was identified as *Brevibacterium ammoniagenes* species according to the methods detailed in Skerman's *Guide to the Identification of the Genera of Bacteria*,[6] and *Bergey's Manual of Determinative Bacteriology*.[7]

The antibiotic production by this isolate when grown in a liquid medium containing glucose (2%), yeast extract (0·25%) and peptone (1%), at pH 7·2, was maximal at the end of 72 hours when incubated on a rotary shaker (200 rpm) at room temperature (*ca.* 30° C.). This was associated with a drop in the pH upto 4·5. Other liquid media like nutrient broth, cornsteep-liquor-peptone-yeast extract broth supported good growth of the organism, but failed to induce antibiotic production.

The antibiotic activity was not extractable in hexane, benzene and other non-polar solvents; but could be quantitatively extracted in diethyl ether, and chloroform. These solvents were then used to extract the active principle from the culture filtrate.

The crude extract on purification on preparative TLC using Silica Gel G (E. Merck), as adsorbent, in a solvent system containing 10% methanol in chloroform gave two active fractions with R_f values 0·85 and 0·23, respectively. These have been tentatively designated by us as Brevimycin A and Brevimycin B to commemorate the genus responsible for their production.

Both Brevimycin A and Brevimycin B are soluble in dilute alkali but insoluble in dilute HCl (2 N). They are sparingly soluble in acetone and ethanol.

The antibiotic complex being predominant in Brevimycin A, this substance was obtained in quantities to study the antibiotic spectrum.

This fraction, Brevimycin A, was very active against a variety of bacteria as is seen from Table I which gives the minimum inhibitory concentration for the various test organisms.

TABLE I

Minimum inhibitory concentration (MIC) of antibiotic Brevimycin A

Test Organism	MIC μg./ml.
S. aureus 3750	75
Strep. β hemolyticus	15
D. pneumoniæ	15
S. typhosa H_{901}	90
Sh. dysenteriæ	90
E. coli 0119	90
Ps. pyocyanea (*Ps. aeruginosa*)	95
V. choleræ Ogawa	95

On the basis of the information, on hand, of chemical characterisations, Brevimycin A seems to be an aliphatic carboxylic acid of the butyric acid series, showing a certain degree of unsaturation and the presence of a hydroxyl group.

Efforts towards the elucidation of the chemical nature and probable structure of Brevimycin A and Brevimycin B (active principle, having R_f 0·23 in the methanol-chloroform system) as well as details of fermentation process are in progress.

---

1. Rao, G. S., Bannur, B. B. and Purandare, G. M., *Hindustan Antibiot. Bull.*, 1967, **10**, 7.
2. — — and Purandare, G. M., *Ibid.*, 1968, **11**, 20.
3. Bannur, B. B. and Purandare, G. M., *Ibid.*, 1969, **12**, 27.
4. Langlykke, A. F., *Fermentation Advances*, Perlman D. (ed.) Academic Prees, New York, 1969, p. 883.
5. Kasturi, K. and Tamhane, D. V., *Curr. Sci.*, 1969, **38**, 92.
6. Skerman, V. B. D., *A Guide to the Identification of the Genera of Bacteria*, 2nd Edition, Williams and Wilkins, Baltimore, 1967.
7. Breed, R. S., Murray, E. G. D. and Smith, N. R. (Eds.), *Bergey's Manual of Determinative Bacteriology*, 7th Edition, Williams and Wilkinss, Baltimore, 1957.

LETTERS TO THE EDITOR

VIBRATIONAL SPECTRA OF DEUTERATED ANILINE

The introduction of deuterium atoms leaves essentially unchanged all properties of aniline molecule associated with the electronic structure and force field but affects those properties dependent on the mass notably the vibrational frequencies. Therefore, the introduction of isotope provides a very powerful tool for sorting out different kinds of molecular vibrations. The aniline molecule, as evidenced by many indirect evidences,[1-3] belongs to C_s symmetry. So the 36 fundamental vibrations of deuterated aniline are divided into two parts, 25 to symmetric vibrations a' and 11 to non-symmetric vibrations a''. Table I shows the assignments of the vibrational frequencies of deuterated aniline and comparison to the respective aniline frequencies.[4]

TABLE I

Comparison of fundamental ground state vibrations of aniline and aniline-d_7

Aniline	Aniline d_7	Assignment
3440	2532	a', ND$_2$ stretch
3360	2465	a', ND$_2$ stretch
3088	2280	a', C—D stretch
3063	2260	a', C—D stretch
1602	1575	a', ring stretch
1586	1464	a', ring stretch
1468	1426	a', ring stretch
1501	1403	a', ring stretch
1279	1290	a', C—N D$_2$ stretch
1309	1252	a', ring stretch
1618	1194	a', N—D$_2$ bend i.p.
1326	1067	a', C—D bend i.p.
984	975	a', ring deform i.p.
998	952	a', ring breath
1175	923	a', C—D bend i.p.
1155	867	a', C—D bend i.p.
1120	835	a', C—D bend i.p.
812	817	a', C—N D$_2$ bend i.p.
1029	807	a', C—D bend i.p.
1054	752	a'', ND$_2$ twist
959	740	a'', C—D bend o.p.
618	520*	a', ring deform. i.p.
415	424*	a'', ring deform o.p.
233	209*	a'', ring deform o.p.

* These values are obtained from ultraviolet absorption studies.[5]

The samples of aniline and aniline-d_7 were obtained by B.A.R.C., Trombay, and they were used without further purification. The infrared absorption spectra were recorded on H-800 Spectrophotometer fitted with sodium chloride optics.

We are grateful to Dr. D. Sharma for his encouragement.

Department of Physics, J. N. Rai.
University of Gorakhpur, R. C. Maheshwari.
Gorakhpur, *April* 28, 1970.

1. Bhattacharya, T. J., *Ind. J. Phys.*, 1962, **36**, 533.
2. Aroney, M. and Le Fevre, R. J. W., *J. Chem. Soc.*, 1956, p. 2775.
3. Weissberger, A. and Sangewald, R., *Z. Physik. Chem.*, 1929, **35**, 237.
4. Evans, J. C., *Spectrochim. Acta*, 1960, **16**, 428.
5. Rai, J. N. and Maheshwari, R. C., Unpublished work.

ON THE DEPOSITION OF CRYSTALLINE MATTER IN URINARY CALCULI

Urinary calculi are known to consist of both crystalline as well as colloidal matter.[1,2] The interrelationship between the colloidal and the crystalline components of bladder stones is none-too-well understood. The mechanism of formation and pathogenesis of urinary calculi are, also, still obscure. An electron-optical study of the nature and mode of crystallisation in bladder stones is in progress in this laboratory and the present report deals with some preliminary results of electron micrographic studies.

The calculi studied were from Delhi area where the disease is endemic amongst children belonging to poor families.[3] The stones were chocolate-brown in colour with a nodular surface.[3] Some of the stones were as much as an inch long in cross-section. The calculi were cut into two halves and small sections of the stones were scooped out from different regions and carefully powdered in an agate mortar. The powdered samples were first examined by X-ray powder diffraction employing Cu K_α radiation from a Philips 1010 X-ray diffraction unit. X-ray diffraction data indicated the presence of whewellite (calcium oxalate monohydrate) and acid ammonium urate as the main components.

The powdered samples were then examined in a Philips EM-100 electron microscope. For this purpose, specimens were prepared by allowing a drop of dilute aqueous suspension of the powdered sample to evaporate on a cellulose acetate substrate which was supported on a 200 mesh copper grid.

BREVIMYCINS, A NEW GROUP OF ANTIBIOTIC SUBSTANCES FROM A *BREVIBACTERIUM* SP. ISOLATE

K. KASTURI AND D. V. TAMHANE
Department of Chemical Technology, University of Bombay, Bombay-19

ANTIBIOTICS have now been isolated from a variety of fungi, streptomycetes, algæ, bacteria and lichens.[1–3] They vary widely in their spectrum of activity and chemical nature. Although nearly 1,100 antibiotic substances are discovered, only 66 have attained the level of commercial application.[4] Certain antibiotics, especially those of bacterial origin, are now gaining importance due to lack of resistance to them by the susceptible organisms.

Of the bacterial species, the organisms belonging to the genera *Bacillus, Clostridium* and *Pseudomonas* are of added interest due to the wide variety of antibiotics produced by them, as well as, the variety of antibiotics produced by the same species. Quite a few organisms belonging to other genera have also been attributed with the capacity for antibiotic production.[1]

While studying soil samples from oil-bearing areas, by using the dilution plate technique, a few isolates showing characteristic antagonism to others in their vicinity were encountered.[5] One of these isolates, which showed promising activity, was taken up for detailed study. This isolate, a gram-positive bacterium, was identified as *Brevibacterium ammoniagenes* species according to the methods detailed in Skerman's *Guide to the Identification of the Genera of Bacteria*,[6] and *Bergey's Manual of Determinative Bacteriology*.[7]

The antibiotic production by this isolate when grown in a liquid medium containing glucose (2%), yeast extract (0·25%) and peptone (1%), at pH 7·2, was maximal at the end of 72 hours when incubated on a rotary shaker (200 rpm) at room temperature (*ca.* 30° C.). This was associated with a drop in the pH upto 4·5. Other liquid media like nutrient broth, cornsteep-liquor-peptone-yeast extract broth supported good growth of the organism, but failed to induce antibiotic production.

The antibiotic activity was not extractable in hexane, benzene and other non-polar solvents; but could be quantitatively extracted in diethyl ether, and chloroform. These solvents were then used to extract the active principle from the culture filtrate.

The crude extract on purification on preparative TLC using Silica Gel G (E. Merck), as adsorbent, in a solvent system containing 10% methanol in chloroform gave two active fractions with R_f values 0·85 and 0·23, respectively. These have been tentatively designated by us as Brevimycin A and Brevimycin B to commemorate the genus responsible for their production.

Both Brevimycin A and Brevimycin B are soluble in dilute alkali but insoluble in dilute HCl (2 N). They are sparingly soluble in acetone and ethanol.

The antibiotic complex being predominant in Brevimycin A, this substance was obtained in quantities to study the antibiotic spectrum.

This fraction, Brevimycin A, was very active against a variety of bacteria as is seen from Table I which gives the minimum inhibitory concentration for the various test organisms.

TABLE I

Minimum inhibitory concentration (MIC) of antibiotic Brevimycin A

Test Organism	MIC μg./ml.
S. aureus 3750	75
Strep. β hemolyticus	15
D. pneumoniæ	15
S. typhosa H_{901}	90
Sh. dysenteriæ	90
E. coli 0119	90
Ps. pyocyanea (*Ps. aeruginosa*)	95
V. choleræ Ogawa	95

On the basis of the information, on hand, of chemical characterisations, Brevimycin A seems to be an aliphatic carboxylic acid of the butyric acid series, showing a certain degree of unsaturation and the presence of a hydroxyl group

Efforts towards the elucidation of the chemical nature and probable structure of Brevimycin A and Brevimycin B (active principle, having R_f 0·23 in the methanol-chloroform system) as well as details of fermentation process are in progress.

---

1. Rao, G. S., Bannur, B. B. and Purandare, G. M., *Hindustan Antibiot. Bull.*, 1967, **10**, 7.
2. — and Purandare, G. M., *Ibid.*, 1968, **11**, 26.
3. Bannur, B. B. and Purandare, G. M., *Ibid.*, 1969, **12**, 27.
4. Langlykke, A. F., *Fermentation Advances*, Perlman D. (ed.) Academic Press, New York, 1969, p. 883.
5. Kasturi, K. and Tamhane, D. V., *Curr. Sci.*, 1969, **38**, 92.
6. Skerman, V. B. D., *A Guide to the Identification of the Genera of Bacteria*, 2nd Edition, Williams and Wilkins, Baltimore, 1967.
7. Breed, R. S., Murray, E. G. D. and Smith, N. R. (Eds.), *Bergey's Manual of Determinative Bacteriology*, 7th Edition, Williams and Wilkinss, Baltimore, 1957.

LETTERS TO THE EDITOR

VIBRATIONAL SPECTRA OF DEUTERATED ANILINE

THE introduction of deuterium atoms leaves essentially unchanged all properties of aniline molecule associated with the electronic structure and force field but affects those properties dependent on the mass notably the vibrational frequencies. Therefore, the introduction of isotope provides a very powerful tool for sorting out different kinds of molecular vibrations. The aniline molecule, as evidenced by many indirect evidences,[1-3] belongs to C_s symmetry. So the 36 fundamental vibrations of deuterated aniline are divided into two parts, 25 to symmetric vibrations a' and 11 to non-symmetric vibrations a''. Table I shows the assignments of the vibrational frequencies of deuterated aniline and comparison to the respective aniline frequencies.[4]

TABLE I

Comparison of fundamental ground state vibrations of aniline and aniline-d$_7$

Aniline	Aniline d_7	Assignment
3440	2532	a', ND$_2$ stretch
3360	2465	a'', ND$_2$ stretch
3088	2280	a', C–D stretch
3063	2260	a', C—D stretch
1602	1575	a', ring stretch
1586	1464	a', ring stretch
1468	1426	a', ring stretch
1501	1403	a', ring stretch
1279	1290	a', C–N D$_2$ stretch
1309	1252	a', ring stretch
1618	1194	a', N–D$_2$ bend i.p.
1326	1067	a', C–D bend i.p.
984	975	a', ring deform i.p.
998	952	a', ring breath
1175	923	a', C–D bend i.p.
1155	867	a', C–D bend i.p.
1120	835	a', C–D bend i.p.
812	817	a', C–N D$_2$ bend i.p.
1029	807	a', C–D bend i.p
1054	752	a'', ND$_2$ twist
959	740	a'', C–D bend o.p.
618	520*	a', ring deform. i.p.
415	424*	a'', ring deform o.p.
233	209*	a', ring deform o.p.

* These values are obtained from ultraviolet absorption studies.[5]

The samples of aniline and aniline-d_7 were obtained by B.A.R.C., Trombay, and they were used without further purification. The infrared absorption spectra were recorded on H-800 Spectrophotometer fitted with sodium chloride optics.

We are grateful to Dr. D. Sharma for his encouragement.

Department of Physics, J. N. RAI.
University of Gorakhpur, R. C. MAHESHWARI.
Gorakhpur, *April* 28, 1970.

1. Bhattacharya, T. L., *Ind. J. Phys.*, 1962, **36**, 633.
2. Aroney, M. and Le Fevre, R. J. W., *J. Chem. Soc.*, 1956, p. 2775.
3. Weissberger, A. and Sangewald, R., *Z. Physik. Chem.*, 1929, **35**, 237.
4. Evans, J. C., *Spectrochim. Acta*, 1960, **16**, 428.
5. Rai, J. N. and Maheshwari, R. C., Unpublished work.

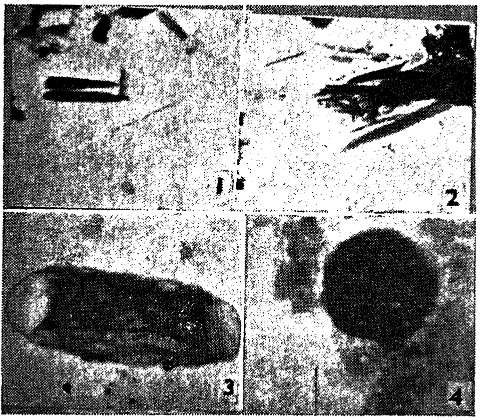
ON THE DEPOSITION OF CRYSTALLINE MATTER IN URINARY CALCULI

URINARY calculi are known to consist of both crystalline as well as colloidal matter.[1,2] The interrelationship between the colloidal and the crystalline components of bladder stones is none-too-well understood. The mechanism of formation and pathogenesis of urinary calculi are, also, still obscure. An electron-optical study of the nature and mode of crystallisation in bladder stones is in progress in this laboratory and the present report deals with some preliminary results of electron micrographic studies.

The calculi studied were from Delhi area where the disease is endemic amongst children belonging to poor families.[2] The stones were chocolate-brown in colour with a nodular surface.[2] Some of the stones were as much as an inch long in cross-section. The calculi were cut into two halves and small sections of the stones were scooped out from different regions and carefully powdered in an agate mortar. The powdered samples were first examined by X-ray powder diffraction employing Cu K$_\alpha$ radiation from a Philips 1010 X-ray diffraction unit. X-ray diffraction data indicated the presence of whewellite (calcium oxalate monohydrate) and acid ammonium urate as the main components.

The powdered samples were then examined in a Philips EM-100 electron microscope. For this purpose, specimens were prepared by allowing a drop of dilute aqueous suspension of the powdered sample to evaporate on a cellulose acetate substrate which was supported on a 200 mesh copper grid.

Three distinct kinds of crystallisation on amorphous substrates were observed in the electron-micrographic scannings. The first kind was in the form of rods (Fig. 1) with one pointed end. The density of crystalline material within these rods was not necessarily uniform; at high magnification, the opacity to electrons varied along the length of many rods scanned. Apparently, this type of precipitation occurred in fibrils, lacking any fine structure, shown in Fig. 2. The fibrils, which are not crystalline, in the sense that they do not give any electron diffraction pattern, are most probably organic in nature.



FIGS. 1–4. Different kinds of crystallization in urinary calculi. Fig. 1. Crystalline rods (× 4,000) Fig. 2. Amorphous hollow fibrils in which precipitation occurs (× 4,200). Fig. 3. Discrete crystallites on the surface of amorphous cylindrical substrate, white patches indicate places from which crystallites were dislodged (× 9,000). Fig. 4. Globular matrix containing crystallites (× 12,000).

Figure 3 illustrates a second kind of crystallisation. In this case, small discrete crystallites were found lodged on the surface of hollow cylinders; the precipitation was not continuous within the amorphous cylindrical substrates. Some of the crystallites were dislodged from their positions most probably when the calculi were powdered.

Another kind of crystallisation was found to occur in globular substrates (Fig. 4). The globules have the appearance of coacervates in which crystallisation has occurred. The outer portion of the globules were amorphous to electrons.

It is clear from the above that more than one mode of precipitation of crystalline matter on amorphous organic matrices is operative in the formation of urinary calculi.

Author's thanks are due to Dr. A. L. Aurora for samples of calculi and helpful discussions, and to Prof. R. M. Barrer, London, for making available an EM-100 electron microscope.

Dept of Chemistry, M. V. R. Rao.
University of Delhi,
Delhi-7, *May* 9, 1970.

1. Murphy, B. T. and Pyrah, L. N., *British Journal of Urology*, 1962, **34**, 129.
2. Aurora, A. L., Ramalingaswamy, V. and Gaitonde, P. D., *The Journal of Urology*, 1964, **91**, 347.

AGE OF THE TIPAM SANDSTONES

Ever since the discovery[1] of vertebrate fossils in the upper beds of the Boka Bil stage of the Surma Series in Assam, the age of the overlying Tipam Sandstones has been in doubt. On the evidence of marine invertebrate fossils[2] palæontologists assigned a Pliocene age to the Tipam Sandstones but because of absence of any break in sedimentation and partly because the Tipam Sandstones laterally merge into the Boka Bil beds, field geologists urged a Miocene age for the beds, which prevailed. The mammalian fossils recently discovered in the underlying Boka Bil beds include *Dorcatherium* sp. which first appears in the Nagri stage of the Siwaliks and the Nagri stage has been dated by Lewis[3] as belonging to the Pontian. The Tipam Sandstones must therefore be younger than the Boka Bil beds or at most of Pontian age, if they laterally merge with the latter.

Hill Side Lane, S. K. Borooah.
P.O., Silpukhuri,
Gauhati-3, *May* 1, 1970.

1. Trivedi, A. N., *Curr. Sci.*, **1966**, **35** (3).
2. Sale, H. M. and Evans, P., "Assam Arakan oil region," *Geo. Mag.*, 1940, **77**, 353.
3. Lewis, G. E., "A new Siwalik correlation," *Am. Jour. Sci.*, 1937, **33**, 191.

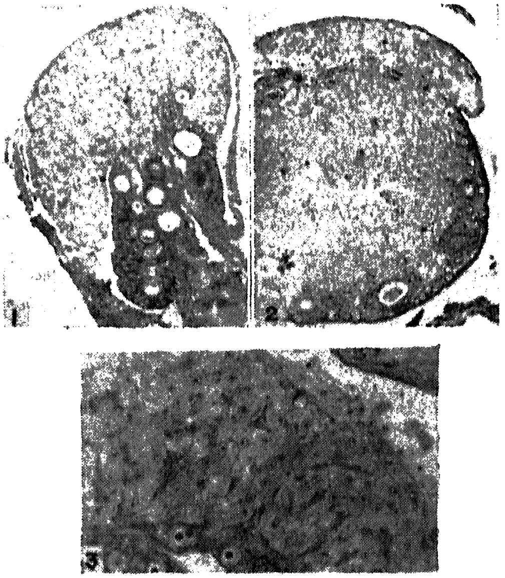
EXTROVERT CORPUS LUTEUM IN TWO SPECIES OF INDIAN BATS

The occurrence of the extrovert corpus luteum is a rare phenomenon among the mammals and has been noticed in two species of British horse-shoe bats (Matthews, 1937), in the African insectivore, *Elephantulus myurus* (Van der Horst and Gillman, 1940, 1942), and in the mouse-tailed bat, *Rhinopoma kinneari* (Anand Kumar, 1965). While investigating the development of the corpus luteum in several species of Indian bats in this laboratory it was noticed that the corpus luteum becomes completely extroverted in *Hipposideros fulvus*

fulvus (Family—Hipposideridae) and partially extroverted in *Megaderma lyra lyra* (Family—Megadermatidae). Both these species have an annual reproductive cycle and breed in a sharply defined season. Copulation takes place in the second week of November, and is immediately followed by fertilization and pregnancy. The young ones are delivered late in April. In both the species there is an unusual physiological dominance of the left ovary over the right, and a single Graafian follicle attains full development during each reproductive cycle. The pre-ovulatory follicle occurs near the periphery of the ovary near its ob-hilus end. Immediately after ovulation the granulosa cells of the Graafian follicle ooze out of the ruptured end. Within a very short period the entire granulosa layer becomes exposed and extroverted in *Hipposideros fulvus fulvus*. In the case of *Megaderma lyra lyra* only a part of the granulosa layer becomes extroverted. Hence the entire corpus luteum is outside the ovary in *Hipposideros fulvus fulvus*, whereas only a part of the corpus luteum is outside the ovary in *Megaderma lyra lyra*. When fully formed the corpus luteum of *Hipposideros fulvus fulvus* is larger than the rest of the ovary and occurs as a thick cap over the distal end of the ovary. Figures 1 and 2 are photomicrographs of the ovary with the corpus luteum in *Hipposideros fulvus fulvus* and *Megaderma lyra lyra* respectively.

The granulosa cells undergo hypertrophy and become vacuolated and luteinized, and contain a single large vesicular nucleus each (Fig. 3). The cells of the theca interna quickly migrate into the developing corpus luteum and form thin strands of fibrous-like cells between the luteinized cells. The zone between the extroverted corpus luteum and the rest of the ovary contains remnants of the theca externa and blood capillaries in *Hipposideros fulvus fulvus*. Numerous blood capillaries extend from the base of the corpus luteum and spread over distally just below the surface of the corpus luteum.

While describing the structure of the ovaries of some bats, Gopalakrishna and Moghe (1960) mentioned that in all the bats they studied including *Megaderma lyra lyra* the corpus luteum lies within the confines of the ovary. Either they did not get the very early stages of the development of the corpus luteum in this bat or they misinterpreted the vascularized peripheral surface of the corpus luteum as the cortex of the ovary.



FIGS. 1-3 Fig. 1. Ovary with the corpus luteum in *Hipposideres fulvus fulvus*, × 45. Fig. 2. Ovary with corpus luteum in *Megaderma lyra lyra*, × 45. Fig. 3. Part of the corpus luteum of *Hipposideros fulvus fulvus* to show the hypertrophied vacuolated luteinized cells seperated by fine fibrous strands, × 160.

In the two species of bats studied here the corpus luteum is short-lived and starts regressing soon after the embryo is completely implanted. In both the species the corpus luteum becomes completely regressed after the formation of the chorio-vitelline placenta. It is pertinent to mention here that the chorio-vitelline placenta becomes completely organized at a very early stage of gestation. Perhaps the early regression of the corpus luteum in these bats may be related to the fact that its endocrine function is taken over by the well-organized placenta at an early stage of pregnancy.

Whereas the corpus luteum normally develops within the confines of the ovary in most mammals, the reasons for the formation of the extrovert corpus luteum in a few mammals are not known.

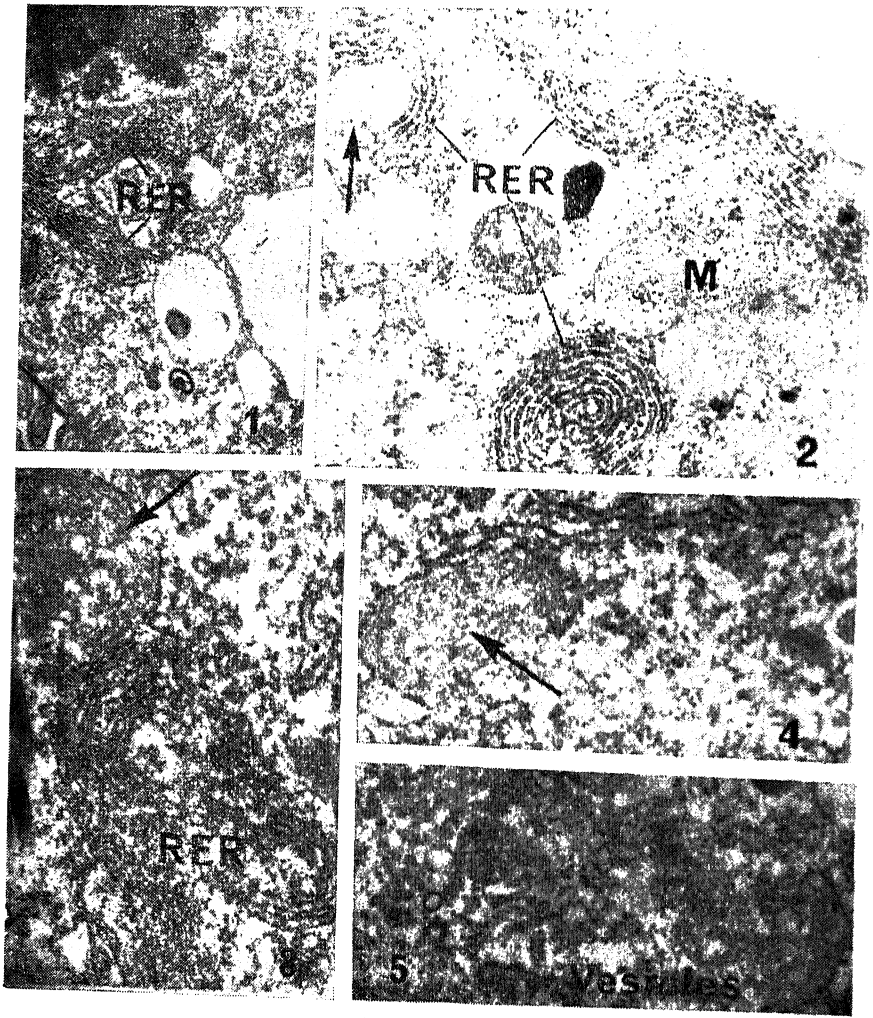
Dept. of Zoology, A. GOPALAKRISHNA.
Institute of Science, D. R. PATIL.
Nagpur, *May* 20, 1970. MISS R. NAGARAJAN.

---

1. Anand Kumar, T., *Jour. Zool. London*, 1965, **147**, 147.
2. Gopalakrishna, A. and Moghe, M. A., *Proc. Nat. Inst. Sci. India*, 1960, **26**, 11.
3. Matthews, L. H., *Trans. Zool. Soc. London*, 1937, **23**, 224.
4. Van der Horst, C. J. and Gillman, J., *Nature*, 1940, **145**, 974.
5. — and —, *South African J. Med. Sci.*, 1942, **7**, 21.

ULTRASTRUCTURAL EVIDENCE OF HEAVY PROTEIN SYNTHESIS IN *ANCISTROCOMA PELSENEERI* (THIGMOTRICHIDA : CILIATA)

Of all the important functions of endoplasmic reticulum, the one that has received most attention during the recent past is that of protein synthesis. This activity is carried out specially by the rough endoplasmic reticulum (RER) of the cells in metazoa. The cells which are designed for heavy protein synthesis, *e.g.*, liver, pancreas or the lactating epithelial cells of mammary gland, etc., show great activity of RER and the cisternæ of RER form the predominant feature of the cellular structure. They are seen forming parallel contours or stacks of whorls. Ultrastructural evidence shows that activity of RER, similar to the secreting gland cells mentioned above, is present in this ciliate also.



FIGS. 1–5

The RER is found in stacks forming various configurations. As parallel stacks it is seen near the macronucleus and in other parts of the cell body (Figs. 1, 2 and 3). In one of the whorl stacks, the innermost whorl seems to have lost its ribosomes and becomes smooth ER. A space also develops in the centre of the whorls and one or two vesicles (arrow) appear in this area too (Fig. 2). In some other whorl stacks this space seems to have increased and the number of vesicles in it has also increased. Such whorl stacks possess less number of whorls as compared to the whorl stacks of Fig. 2. In another stack of whorls a stage has reached in which the number of whorls has reduced to just one and with an increased central space the number of vesicles has also increased (Figs. 3 and 4). This stage seems to have been further developed in certain area of the cytoplasm where the only surrounding whorl of RER has also moved away and the vesicles are released in the cytoplasm (Fig. 5).

Conclusions.—The presence of high activity of RER similar to the cells designed for heavy protein synthesis suggests that possibly there is an active synthesis of protein taking place in *Ancistrocoma* also. Histochemical tests at the light microscope level show that there exists a mucoprotein complex in the mucigenic bodies of this ciliate. Mucigenic bodies are one of those many well-known organelles of the ciliates which eject mucoid substance under certain physico-chemical stimuli. These bodies are seen abundantly in *Ancistrocoma* and are used constantly to eject their contents outside the body. It is possible that the protein synthesis activity of the cell is directed towards the production of mucoprotein complex of the mucigenic bodies. The secretive activity of the cell is further supported by the formation of vesicles inside the whorls of RER. These vesicles may ultimately be developing into precursors of mucigenic bodies.

Department of Zoology, M. A. Khan.*
University College of Swansea,
Swansea (U.K.), *May* 26, 1970.

---

* Present address: Department of Zoology, Osmania University, Hyderabad-7, India.

1. Hultin, T., *Biochem. Pharmacol.*, 1961, **5**, 359.
2. Ncquillon, K., *Progress in Biophys. Biochem.*, 1962, **12**, 69.
3. Palade, G. E., *J. Biophys. Cytol.*, 1955, **1**, 59.
4. Siekevitz, P., *Expr. Cell Res.* (*Suppl*), 1951, **7**, 90.

EFFECT OF ADRENALIN ADMINISTRATION ON THE CHROMATOPHORES OF THE PRAWN *METAPENAEUS MONOCEROS* (FABR.)

Very few reports have appeared on the effect of pharmacological agents on the chromatophores of Crustaceans.[1-3] Beauvallet and Veil[4] have reported that adrenalin has a darkening effect when injected to *Palæmon*. In *Leander adspersus*[1] and *Orconectes virilis*[5] injection of adrenalin produced dispersion of red pigment. But on the other hand in *Palæmon paucidens*, Aoto[3] did not observe any change in the state of the red pigment after administration of adrenalin. Among brachyurans, injection of adrenalin to destalked *Gelasimus annulipis*[6] evoked dispersion of red pigment, whereas similar treatment was without any effect on the melanophores of *Uca pugilator*.[7] As these reports on pigment responses to adrenalin treatment are not uniform it is necessary to extend these investigations to other crustacean species. The following account deals with the responses of the pigments within the chromatophores to injection of adrenalin in the prawn *Metapenæus monoceros*.

The prawns under investigation measuring 6 to 8 cm. in total length were collected from Mahim estuary on the Bombay Coast and kept in an aquarium containing sea-water for acclimatization. After two days, twenty intact prawns were selected from the stock aquarium and divided into two groups of ten each and kept in sea-water in two separate white containers under illumination (100 watt bulb at a distance of 30 cm.). After they had fully adapted to white background, each animal of one group received 0·05 c.c. of adrenalin (BDH, 1 : 1000), whereas the animals belonging to the other group (Control) received 0·05 c.c. of sea-water. The red, yellow and black pigments within the trichromatic chromatophores of the uropods of each animal of the respective group were staged according to the system of Hogben and Slome[8] prior to injection and then 5, 10, 15, 30, 45 and 60 minutes after the injection. The results obtained are presented in Fig. 1.

In the white-adapted animals, the red, yellow and black pigments are fully concentrated before injection of adrenalin. From Fig. 1, it is obvious that injection of adrenalin when given to these white-adapted animals causes dispersion of these pigments. The degree of dispersion is greatest in the red pigment and least in the black pigment. The yellow pigment shows an intermediate condition. The administration of adrenalin to destalked prawns and also to the intact ones adapted to black background has no effect on the dispersed state of the three pigments within the chromatophores.

The injection of adrenalin to prawn adapted to white background brought about dispersion of red, yellow and black pigments. This finding is in agreement with those reported in

Leander adspersus,[1] *Gelasimus annulipis*[6] and *Orconectes virilis*[5] but is at variance with the findings made in *Palæmon paucidens*[3] and *Uca pugilator*.[7] The reason behind this difference in the response to adrenalin treatment is not clearly understood.

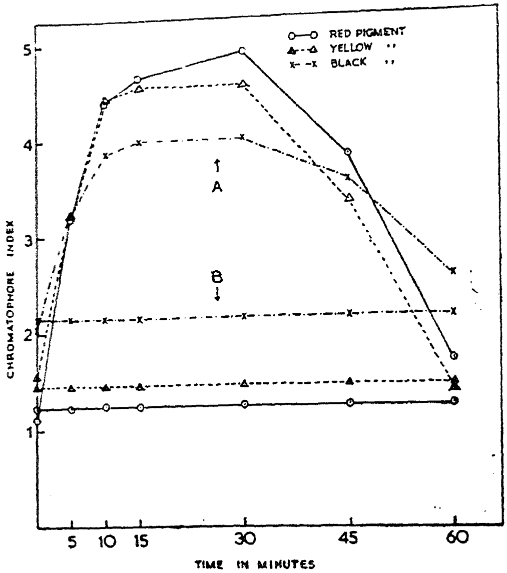


FIG. 1. Responses of the red, yellow and black pigments of white-adapted prawns, *M. monoceros* to adrenalin injection. A—animals receiving adrenalin injection. B—animals receiving sea-water injection.

Animal Physiology Division, P. V. RANGNEKER.
Zoology Department, M. N. MADHYASTHA.
Institute of Science,
Bombay-32, *April* 14, 1970.

1. Ostlund, E. and Fange, R., *Annls. Sci. nat. Zool. Biol. Animale.*, 1956, **18**, 325.
2. Florey, E., *Biol. Zbl.*, 1952, **71**, 499.
3. Aoto, T., *J. Fac. Sci. Hokkaido Univ.*, 1963, **15**, 177.
4. Beauvallet, N. and Veil, C., *C. R. Soc. Biol. Parise.*, 1934, **117**, 688.
5. McVay, J. A., As cited by Aoto, T., 1963.
6. Nagabushanam, R., *Sci. & Cult.*, 1966, **32**, 429.
7. Abramowitz, A. A. and Abramowitz, R. K., *Biol. Bull., Woods Hole*, 1938, **74**, 278.
8. Hogben, L. T. and Slome, D., *Proc. Roy. Soc., Lond.*, 1931, **108 B**, 10.

ISOLATION OF *SALMONELLA TSHIONGWE* (6, 8 : *e*, *h* : *e*, *n*, *z* 15) FROM A GUINEA-PIG

SALMONELLOSIS is one of the most devastating infections which can occur in guinea-pig colonies. *Salmonella typhimurium* and *Salm. enteritidis* have been incriminated as the common causal organisms of fulminating epidemics in guinea-pigs (Harris, 1962).

Freeman (1948) isolated *Salm. poona* from a guinea-pig in an epizootic infection. Ghosh and Chatterjee (1960) recorded the first natural outbreak of septicæmia in guinea-pigs in the country due to *Salm. dublin*. Jayraman *et al.* (1964) described an outbreak of salmonellosis in guinea-pigs due to *Salm. weltevreden*. Other *Salmonella* serotypes which have been reported from guinea-pigs in India are *Salm. anatum*, *Salm. enteritidis*, *Salm. typhimurium*, *Salm. derby* and *Salm. worthington* (Khera, 1968).

This note records the isolation of *Salm. tshiongwe* from a dead guinea-pig which on necropsy examination revealed lesions suggestive of septicæmia. The isolation of this serotype has been reported earlier from meat animals and food stuffs (Kelterborn, 1967).

The organism was isolated by direct culture from the heart-blood on MacConkey's lactose agar. The isolate was identified as *Salmonella* biochemically and for serological typing the culture was sent to the National Salmonella and Escherichia Centre, Kasauli.

The organism was motile and formed colonies which were semi-translucent, smooth, circular with entire edge and low convex. It did not hydrolyse urea and was M.R. positive. Indole and Voges-Proskauer tests were negative. Glucose, mannitol, sorbitol, maltose, trehlose and dulcitol were fermented. It did not ferment inositol, adonitol, salicin, lactose and sucrose. L-lysine HCl, L-ornithine HCl and L-arginine HCl were decarboxylated. Hydrogen sulphide was produced on triple sugar iron agar. It gave a positive nitrate test and was positive for Simmon's citrate.

This organism was found pathogenic to Swiss mice. Inoculation of 0·5 ml. of 24 hours broth culture into mice intraperitoneally killed them within 24–30 hours. *In vitro* antibiotic sensitivity test was carried out using Difco, Bacto-sensitivity discs of medium concentration. The organism was found sensitive to polymyxin B, streptomycin, chloromycetin, neomycin and dihydrostreptomycin.

The authors are thankful to the Director, Central Research Institute, Kasauli, for serological typing of the isolate.

Dept. of Veterinary Pathology, M. P. KAPUR.
College of Vety. Medicine, D. S. KALRA.
Haryana Agricultural Univ.,
Hissar, *May* 14, 1970.

1. Freeman, J. F., *Ind. J. Med. Res.*, 1948, **36**, 75.
2. Ghose, G. K. and Chatterjee, A., *Ind. Vet. Jour.*, 1960, **37**, **144**.
3. Harris, R. J. C., *The Problem of Labratory Animal Disease*, Academic Press, London and New York, 1962, p. **174**.
4. Jayaraman, M. S., Krishnan, R. and Sethumadhavan, V., *Ind. Vet. Jour.*, 1964, **41**, 675.
5. Kelterborn, E., *Salmonella* Species. Dr. W. Junk N. V., Den Haag, 1967, p. 374.
6. Khera, S. S., *Paper presented at the National Seminar on Zoonosis in India*, 1968, 9th to 16th October.

A NOTE ON LICHENS FROM KASHMIR, INDIA

LICHEN collections from the Kashmir valley in the vicinities of Srinagar (*alt. ca.* 5,500 ft.), Gulmarg to Khilanmarg (7,000–9,000 ft.), Pahalgam (8,000 ft.) and Sonamarg (9,000–11,000 ft.) made by the excursion party from the Department of Botany, Lucknow University in 1968, have been examined. The collections at each of the above localities are not exhaustive, but apparently the common and conspicuous lichens have been collected. As exemplified by the numerous common species the lichens from Kashmir exhibit a close relation to the European lichen flora.

Out of the total of 43 species determined, the nine taxa detailed below in the beginning are reported for the first time from the Indian sub-continent as seen on comparison to the Catalogue by Awasthi (1965). This indicates the richness in the lichen flora of Kashmir as well as the possibilities of more interesting finds if exhaustive collections are undertaken.

1. *Verrucaria œthiobola* Wahl. ex Achi—Sonamarg; on submerged stones in the streamlet below the foot of the glacier. Thallus crustaceous, effuse, thin, dark to olivaceous black; perithecia hemispherical, partially immersed, upto 0·3 mm. in diam.; perithecial wall black, 38 μ thick; hymenium hyaline, I + red; spores colourless, simple, ellipsoid, 15–28 × 11 μ. The species is distributed in high mountains of Europe and Eastern Asia.

2. *Calicium abietinum* Pers.—Gulmarg; on bark of conifer tree. Thallus thin, ashy granulose to evanescent; stipe thin, erect, black; disc black, pruinose; spores brown-black, 2-celled, ellipsoid, 11–12 × 3·5–4 μ. The species is widely distributed in the temperate regions of the world.

3. *Catillaria atropurpurea* (Schaer.) Th.Fr.—Gulmarg; on dead wood. Thallus evanescent; apothecia eventually flat to convex; spores colourless, 2-celled, 9–12 × 5–6 μ. The species is well distributed in temperate regions of the world and always occurs on dead wood.

4. *Stereocaulon condensatum* Hoffm.—Pahalgam; on sandy soil along river bank. Primary thallus squamulose, persistent; squamules crowded with brown-black cephalodia containing *Stigonema* alga; pseudopodetia short (upto 10 mm.), sterile. The species is distributed in temperate Europe, America and Java.

5. *Peltigera prœtextata* (Flœrker) Zopf—Gulmarg to Khilanmarg; on old wooden logs. Thallus characteristically marginally squamulose-isidiate; underside white-veined, sterile. The species is distributed in temperate regions of the world.

6. *Pertusaria globulifera* (Turn.) Mass. var. *discoidea* (Pers.) Almb.—Gulmarg to Khilanmarg; on bark of coniferous trees. Thallus suborbicular, crustaceous, cracked-wrinkled, greenish-grey; sorelia dense, discoid, large, white. Thallus K-, Cl-, Pd-. The taxon is distributed in the temperate parts of the world.

7. *Parmelia glabra* Nyl.—Gulmarg to Khilanmarg, Pahalgam and on way to Sonamarg (7,000 ft.); on bark of coniferous trees. Thallus brown, non-isidiate and non-sorediate; underside black with rhizinæ; medulla white, K-, Cl + red, KCl + red; apothetica upto 5 mm. in diam.; spores colourless, simple, ellipsoid, 12–14 × 5–7 μ. The species is distributed in temperate regions of Europe, America and Africa.

8. *Parmelia glabratula* (Lamy) Nyl.—Gulmarg and Pahalgam; on bark of conifer trees. Thallus dark brown, densely isidiate; underside black with branched rhizinæ; medulla white, K-, Cl + red, KCl + red, Pd-; scarcely fertile; apothecia upto 5 mm. in diam.; spores colourless, simple, oval to ellipsoid, 7–11 × 5–7 μ. The species is distributed in cooler northern regions of the world.

9. *Parmelia ulophyllodes* (Vain.) Sav.—Khilanmarg and on way to Sonamarg; on bark of conifer trees. Thallus glaucous grey to pale grey, marginally intermittently sorediate; underside grey to brownish with short rhizinæ; medulla white, K-, Cl + red, KCl + red. The species is known from western Siberia.

The additional 34 taxa comprising the collections are:

Dermatocarpon moulinsii (Mont.) Zahl, *D. miniatum* (L.) Mann, *D. vellereum* Zschacke, *Lecidea* sp., *Rhizocarpon tinei* (Tornab.) Rune., *Collema polycarpon* Hoffm., *Leptogium saturninum* (Dicks.) Nyl., *Pelligera canina* (L.) Willd., *P. dolichorhiza* Nyl., *P. horizontalis* (Huds.) Baumg., *P. polydactyla* (Neck.) Hoffm., *P. rufescens* (Weis.) Humb., *Lecanora carpinea* (L.) Ach., *L. chlarotera* Nyl., *L. mnuralis* (Schreb.) Rabenh., *Ochrolechia pallescens* (L.) Mass., *Parmelia borreri* (Sm.) Turn., *P. caperata* (L.) Ach., *P. flaventior* Stirt. (syn. *Parmelia himalayensis* Nyl.), *P. furfuracea* (L.) Ach., *P. scortea* (Ach.) Ach., *P. subargentifera* Nyl. (syn. *Parmelia verruculifera* Nyl.), *P. sulcata* Tayl., *Hypogymnia physodes* (L.) Nyl., *Cetrelia cetrarioides* (Del. ex Duby) Culb. *et* Culb. (syn. *Parmelia cetrarioides* Del. ex Duby), *Evernia divaricata* (L.) Ach., *Ramalina sinensis* Jatta, *Xanthoria candelaria* (Ach.) Arn., *X. substellaris* var. *subsorediosa* Räs., *Buellia montana* H. Magn., *Physcia aipolia* (Ehrh.) Hampe, *Physconia grisea* (Lam.) Poelt (syn. *Physcia grisea* Lam. Zahl.), *Physconia pulverulenta* (Schreb.) Poelt (syn. *Physcia pulverulenta* Schreb. Hampe), *Physconia pulverulenta* var. *argyphœa* (Ach.) Awasthi comb. nov. (syn. *Parmelia pulverulenta* v. *argyphœ* Ach. *Lichengr. Univ.*, p. 474. 1810; and *Physcia pulverulenta* v. *argyphœa* (Ach. Nyl.), and *Anaptychia kaspica* Gyel.

One (K. P. S.) of the authors is thankful to the C.S.I.R., New Delhi, for the award of a Junior Research Fellowship.

Dept. of Botany, DHARANI DHAR AWASTHI.
Lucknow University, KRISHNA PAL SINGH.
Lucknow, *April* 28, 1970.

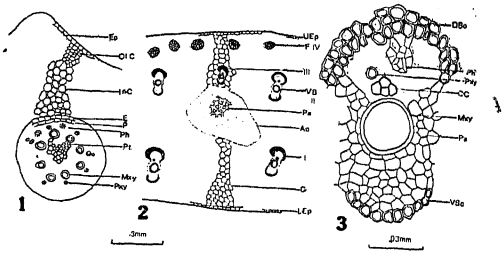
---

1. Awasthi, D. D., "Catalogue of Lichens from India, Nepal, Pakistan and Ceylon." *Beihefte zur Nova Hedwigia*, 1965, Heft 17, p. 137.

SILICIFIED PSEUDOSTEM OF *CANNA* L. FROM EARLY EOCENE OF DECCAN INTERTRAPPEAN BEDS, M.P., INDIA

THE genus *Canna* L. has been known so far in fossil state only by leaf impressions.^{1,2,6} The pseudostem and roots described here are the first petrified fossil record of *Canna*. The material comes from the Deccan Intertrappean beds of Mohgaon Kalan (22° 1′ N., 97° 11′ E.) in district Chhindwara (M.P.), India. The specimen, before sectioning, was 5·4 cm. in length. On sectioning the pseudostem, we came across many roots at it's basal end.

Root (Fig. 1).—The roots are 0·7 to 1·5 mm. in diameter, root hairs absent. Cortex is divisible into outer cortex with compactly arranged hexagonal cells and inner cortex with loosely arranged round cells and intercellular spaces. Both the endodermis and pericycle are one cell thick, the former has casparin thickenings. Xylem strands 8 to 10, radially arranged, protoxylem exarch, metaxylem elements 50–66 μ and protoxylem 17 μ in diameter. Phloem patches indistinct, alternate with xylem. Pith thick-walled and composed of hexagonal cells.



FIGS. 1–3. Fig. 1. T.S. part of fossil petrified root. Fig. 2. A part of leaf-sheath showing fibrous and vascular bundles, and air canal. Fig. 3. A vascular bundle of leaf-sheath showing the tissues. *Ac*, Air canal. *CC*, Commissural connective; *DSc*, Dorsal sclerenchyma; *E*, Endodermis; *Ep*, Epiblema; *F*, Fibrous bundle; *G*, Ground tissue; *InC*, Inner cortex; *Lep*, Lower epidermis; *Mxy*, Metaxylem; *OtC*, Outer cortex; *P*, Perycycle; *Pa*, Parenchyma cells; *Ph*, Phloem; *Pt*, Pith; *Pxy*, Protoxylem; *Uep*, Upper epidermis; *VSc*, Ventral sclerenchyma.

Pseudostem.—Transections of the pseudostem reveal 4 to 6 concentric leaf-sheaths which are wider in the middle but gradually become narrower towards the margins. Each leaf-sheath has vascular bundles in four arcs (I, II, III and IV), a single series of large air canals (Fig. 2) and all these arranged in definite sequence. There are also present fibrous bundles which lie close to the abaxial side of the leaf-sheath (Fig. 2). Air canals have narrow parenchymatous cells which enclose large intercellular spaces (Fig. 2). The epidermal cells are slightly cuticularised.

The vascular bundles are elliptical or dumb-bell-shaped and are characterised by a single large metaxylem vessel sorrounded by xylem parenchyma; furthermore, they possess dorsal and ventral sclerenchymatous sheaths. Few thick-walled cells between metaxylem and phloem probably represent commissural connectives (Fig. 3). Protoxylem within the bundle is situated towards the periphery. Phloem is well preserved (Fig. 3).

The structure of the petrified pseudostem and roots described above have been compared with similar structures found in the various families of the order Scitamineæ.$^{3-5,7}$ It has been observed that very close resemblance exists with the Cannaceæ, specially with the genus *Canna*.

We thank the University Grants Commission for providing financial aid and the Director, Birbal Sahni Institute of Palæobotany, Lucknow, for library facilities.

Department of Botany, B. S. Trivedi.
Lucknow University, C. L. Verma.
Lucknow, *May* 13, 1970.

---

1. Becker, H. F., *Palæontographica*, 1969, **127**, 1.
2. Berry, E. W., *U.S. Geol. Surv. Prof. papers*, 1924, **92**, 206.
3. Jain, R. K., *Nature*, 1969, **187** (4734), 342.
4. —, *The Palæobotanist*, 1963, **12** (1), 45.
5. —, *Ibid.*, 1963, **12** (1), 115.
6. Knowlton, F. H., *U.S. Geol Surv. Prof. papers*, 1923, **131 G**, 183.
7. Rao, A. R. and Menon, V. K., *Proc. Ind. Acad. Sci.*, 1963, **57**, 389.
8. Scolereder, H. and Meyer, J., *Systematische Anamic der Monokotyledonen* (Berlin), 1930, **6**.
9. Tomilnson, P. B., *J. Linn. Soc.* (*Bot.*), 1955, **55**, 547.
10. Winkler, H., *Natural. Pflanzenfamilien*, 1930, **2**, Aulf, Bd. 159.

GROWTH SUBSTANCE CONTENT IN TOMATO SEEDS

Tomato seeds (*Lycopersicum esculentum* Mill), few days after collection from the fruits, showed poor germination while those stored for longer periods germinated well. The presence of some inhibiting substances in tomato juice was shown to be the cause for the failure of germination of the seeds inside the fruits.[1] However, leaching of the seeds was shown to decrease the inhibitor content and improve germination in tomato,[3] Xanthium and lettuce,[8] and in the excised embryos of *Fraxinus excelsior*,[6] and groundnut embryo axis.[4] The present investigation was undertaken to find out the difference, if any, between seeds dried for 48 hours and those stored for longer periods, in their growth substance content.

Seeds were collected from freshly harvested tomato fruits and air-dried for 48 hours and were designated as 'fresh' seeds, and those stored for over six months under laboratory conditions were designated as 'stored' seeds. Both 'fresh' and 'stored' seeds were sown in petriplates (6″ dia.) containing just-moistened (3 ml.) filter-papers. The plates were covered by the lid with moistened filter-paper on the inside to maintain humidity.

The percentage germination of both 'fresh' and 'stored' seeds, at the end of 72 hours after sowing, was 9 and 56 (mean of 3 replications) respectively. The poor germination in the former might be due to the presence of more inhibitors than in the stored ones.

The growth substance content was extracted from both 'fresh' and 'stored' seeds, following the method of Villiers and Wareing.[7] The chromatograms after development were cut into ten equal strips and each strip was eluted in 2% sucrose solution overnight and the eluates were assayed for their biological activity using the rice coleoptile straight growth technique.[2] 2% sucrose solution served as the control.

The growth substance content showed active inhibition in both acidic and neutral fractions of 'fresh' seeds (Fig. 1, A). In the acidic fraction of 'stored' seeds, however, growth inhibition occurred at Rfs 0·5–0·6 and 0·7–1·0 and in neutral fraction at Rfs 0·1–0·3, while the rest of the Rfs in both the fractions showed growth promotion, more so at Rfs 0·0–0·1 and 0·3–0·4 of the acidic fraction (Fig. 1, B). The presence of more inhibitors than the promoters in the 'fresh' seeds and *vice versa* in the 'stored' ones explains the poor germination in the former compared with the latter.

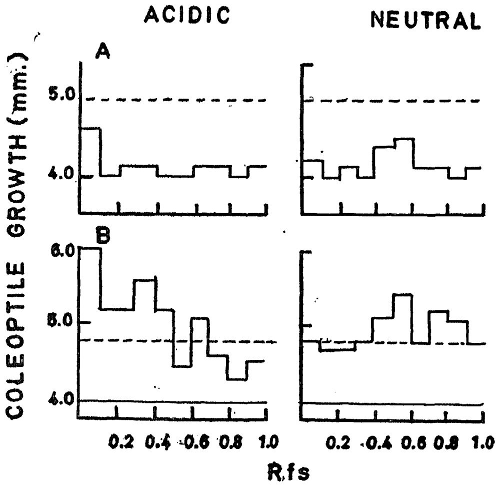


Fig. 1. Growth substance content in (A) 'fresh' seeds and (B) 'stored' seeds. Dotted lines indicate the coleoptile growth in the sucrose control solution.

The inhibitor content decreased and the germination improved in 'fresh' tomato seeds when they were kept for leaching; the leachate collected from the seeds also exhibited the presence of inhibitors, confirming thereby that the poor germination in tomato was only due to inhibitory substances in the seeds.[3] In groundnut (var. TMV.3) seeds also the germination percentage improved with storage, corresponding with a decline in growth inhibitor content and increase in growth promoters.[5] Thus, storage of the tomato seeds for longer periods decreased the inhibitors and enhanced the level of growth promoters.

The first author is grateful to the CSIR for the financial assistance.

Dept. of Botany, V. RAJAGOPAL.
S.V. University, N. SREERAMULU.
Tirupati (A.P.), I. M. RAO.
May 25, 1970.

1. Akkerman, A. M. and Veldstra, H., *Rec. Trav. chim. pays. Bas.*, 1947, **66**, 411.
2. Das, V. S. R, Raju, P. V. and Rao, M. P., *Curr. Sci.*, 1966, **35**, 50.
3. Rajagopal, V., Sreeramulu, N. and Rao, I. M., *J. Indian bot. Soc.*, 1969, **48**, 282.
4. Sreeramulu, N. and Rao, I. M., *Ind. J. Plant Physiol.*, 1968, **11** (1), 78.
5. —, *Ph.D. Thesis*, S.V. University, Tirupati, 1968.
6. Villiers, T. A. and Wareing, P. F., *Nature (Lond.)*, 1960, **185**, 112.
7. — and —, *J. exp Bot.*, 1965, **16**, 533.
8. Wareing, P. F. and Foda, H. A., *Physiologia Planta.*, 1957, **10**, 266.

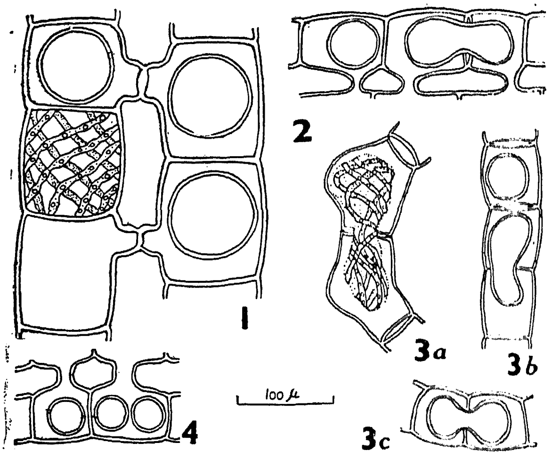
ABNORMAL CONJUGATIONS IN *SPIROGYRA*

SEVERAL forms of abnormal or anomalous conjugation processes have been observed in various species of *Spirogyra*.[1-10] These involve formation of seemingly triploid or tetraploid zygospores,[1-4,6-8] conjugation between three or more cells,[1-4,6-8] gametic fusion across the transverse septum between adjoining cells,[1,5,8,10] and parthenogenetic formation of zygospores by the gametes individually.[7,9,10]

In the course of cytotaxonomic studies on filamentous Conjugales, the authors came across a number of abnormal conjugating processes. It is intended to record them here as they illustrate the range and plasticity of this biological phenomenon within the genus.

In *Spirogyra varifoveolata* Prasad et Dutta[11] most of the cells show normal conjugation and zygospore-formation, but in some cells (Fig. 1), even though the conjugation tubes are produced, azygospores or parthenospores are formed inside either conjugating cell from the gametic protoplasts. It may be mentioned that although cases of similar abnormality have been observed in other species of *Spirogyra*, no information is available on the future fate of such azygospores in any species and it is not known whether such azygospores or parthenospores are viable and capable of germination or not.

In another material of *Spirogyra*, the specific identification of which could not be made due to non-availability of mature zygospores, certain other types of abnormalities were seen. The cells of these filaments measure 50–63 $\mu \times$ 90–158 μ and possess 3–4 chloroplasts making 1·5 to 4 turns in each cell.



FIGS. 1–4. Figs. 1–2. *Spirogyra varifoveolata* Prasad *et* Dutta. A pair of conjugating filaments with one pair of cells forming normal zygospore in the female cell and another pair of cells showing azygospores in both the male and female cells. Figs. 2–4. *Spirogyra* sp. Fig. 2. Conjugating filament showing a normal zygospore and a 'tetraploid' zygospore. Fig. 3 *a*. A filament showing early direct lateral conjugation. Fig. 3 *b* & *c*. Filaments with zygospores formed as a result of direct lateral conjugation and a parthenospore. Fig. 4. Filaments with one normal zygospore and two parthenospores in the female cells.

It was observed that in some cases, the two adjacent female cells of a filament containing fused protoplasts formed as a result of scalariform conjugation got fused together again after dissolution of the transverse septum separating the two female cells and formed a zygospore traversing the two cells (Fig. 2). This zygospore, presumably, is tetraploid. Several authors have called such zygospore as tetraploid but it must be pointed out that this nature cannot be established with certainty without cytological investigation.

In another case, the cells showed direct lateral conjugation. The middle walls (septa) between two adjacent cells dissolve and the contents of the two cells fuse to form a zygospore between the two cells (Fig. 3 *a*–*c*). It is interesting to note here that the gametes in this case behave isogamously producing the zygospore in between the conjugating cells, although in the genus *Spirogyra* as a whole, anisogamy is the rule. Similar cases of direct lateral fusion reported by Iyengar[5] exhibit anisogamy so that the zygospore is lodged in the female cell.

Yet another type of abnormality in conjugation was seen wherein the male gamete after entering the female cell did not fuse with the female protoplast but, instead, both the male and female gametes rounded off inside the female cell forming two parthenospores (Fig. 4).

Dept. of Botany, BRAJ NANDAN PRASAD.
University of Lucknow, SHIPRA DUTTA.
Lucknow-7 (India), *May* 26, 1970.

---

1. Bhandari, M. M. and Goyal, S. K., *Curr. Sci.*, 1961, **30**, 154.
2. Brown, J. G., *Bot. Gaz.*, 1918, **66**, 269.
*3. Carlton William, M. M., *Turtox News*, 1960, **38** (1), 12.
*4. Courda, V., "Conjugales," in *Handbuch d Pflanzenanatomie*, 1937, **6**, 98.
5. Iyengar, M. O. P., *J. Indian bot. Soc.*, 1958, **37** (3), 387.
6. Mahadevan, P. R., *Curr. Sci.*, 1959, **28** (9), 377.
7. Randhawa, M. S., *Zygnemaceae*, 1959, p. 314.
8. Rattan, R. S., *Phykos*, 1968, **7**, 117.
*9. Rosenvinge, L. K., *Oefv. K. Vet. Akad. Foerh. Stockholm*, 1885, **40** (8), 37.
10. West, W. and West, G. S., *Ann. Bot.*, 1898, **12**, 29.
11. Prasad, B. N. and Dutta, S., *J. Indian bot. Soc.* (In press).

* Not seen in original.

CYTOLOGICAL STUDIES IN SOME MEMBERS OF AMARANTHACEAE

AMARANTHACEAE, a small tropical family of 65 genera and 850 species,[6] are of considerable cytological interest. About 56% of the cytologically known species are at various polyploid levels, and aneuploidy is not uncommon. Besides, intraspecific cytotypes are frequently met with. Since the North-West Indian taxa remained untouched cytologically, it was thought desirable to undertake cytological survey of the family from this region with the purpose to record original chromosome counts which might throw light on the cytological evolution of the Indian amaranths. The results of the present investigations are given in Table I.

Alternanthera versicolor with $n = 34$ is a balanced tetraploid and its chromosome number is a new record for the species. But for *Celosia cristata* yellow variety and *Gomphrena globosa*, the chromosomal counts of other species are in agreement with the previous reports.

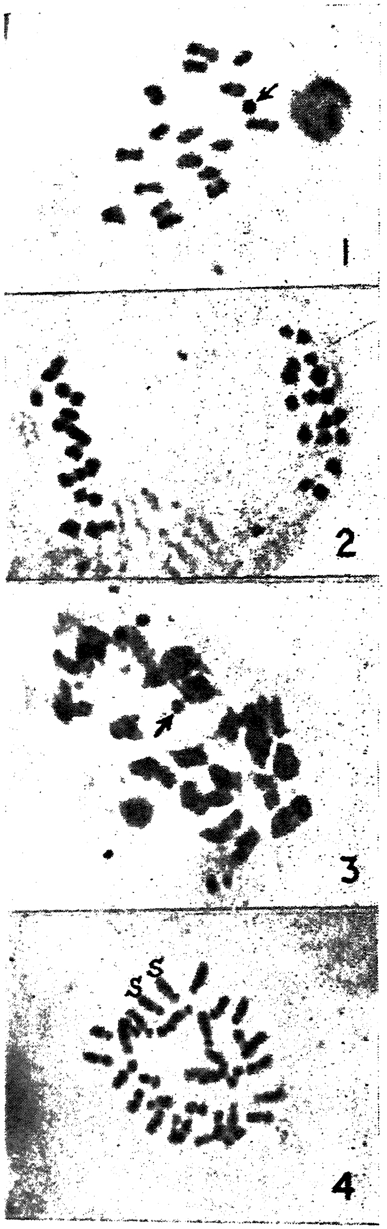
TABLE I

Taxon	Chromosome number	Previous report
Celosia argentia L.	$n=36$	$n=36$; $2n=72$.
C. cristata L.		$n=18$; $2n=36$.
Red variety	$n=18$	
Yellow variety	$2n=35$	
Digera arvensis Forsk.	$n=9$	$2n=12$. $n=9$; $2n=18$.
Amaranthus viridis L.	$n=17$	$n=17$; $2n=34$.
Cyathula tomentosa Moq.	$2n=34$	$n=17$; $2n=34$
Aerua sanguinolenta Bl.	$n=21$	$2n=42$. $2n=44$.
Achyranthes aspera L.	$n=21$	$n=7$. $n=21$; $2n=42$. $n=42$.
Alteranthera versicolor Regl.	$n=34$	
Gomphrena celosioides Mart.	$n=13$	$2n=26$.
G. globosa L.	$n=22+0-1$ B	$2n=32$. $2n=40$. $2n=42$. $n=22$; $2n=44$. $2n=45$–48.

The chromosome number $n = 18$ and $2n = 36$ has been reported for *Celosia cristata*.[1,4,5] A few individuals of the yellow variety of the species are found to have $2n = 35$. In all the PMC's examined at diakinesis and MI, one univalent and 17 bivalents are uniformly observed (Fig. 1). The former lags during AI but occasionally is included in one of the poles (Fig. 2). Pollen sterility is 15-20%. The presence of $17_{II} + 1_{I}$ in the yellow variety and 18_{II} in the red variety coupled with widespread occurrence of $2n = 36$ in the species, are indicative of aneuploid derivation of $2n = 35$ from $2n = 36$ by a loss of one chromosome.

Gomphrena globosa, a cytologically variable species, exists in cytotypes with $2n = 32$[3], $2n = 40$, 42[5] and $2n = 44$–48.[2] The presence of B-chromosome has been recorded for the first time in the species. Figure 3 shows a PMC at MI with one B-chromosome and 22 bivalents. In none of the PMC's more than one B-chromosomes have been observed. However, PMC's without B-chromosomes are quite common.

The somatic number, $2n = 34$, for *Cyathula tomentosa*, worked out from root-tip mitosis, confirms the report of $n = 17$ and $2n = 34$.[4] The karyotype is almost symmetrical with six pairs with median, four pairs with submedian and seven pairs with subterminal primary constrictions (Fig. 4). A submedian pair (SS) possesses a secondary constriction situated submedially in the long arm.



FIGS. 1–4. Figs. 1–2. *Celosia cristata* yellow var. **Fig. 1.** M I with $17_{II} + 1_{I}$, × 2,500. Fig. 2. A I showing 17/18 distribution of chromosomes, × 1,700. **Fig. 3.** *Gomphrena globosa:* diakinesis with one B-chromosome and 22_{II}, × 1,700. **Fig. 4.** *Cyathula tomentosa:* mitotic metaphase with 34 chromosomes, × 1,900.

Our sincere thanks are due to Professor S. S. Bir for facilities and encouragement.

Department of Botany,
Punjabi University,
Patiala-4 (Punjab),
April 18, 1970.

B. S. GILL.
S. VASUDEVA.

---

1. Grant, W. F., *Bot. Gaz.*, **1954**, **115**, 323.
2. —, Love, A. and Love, D., *Opera Botanical*, **1961**, **5**, 1–581.
3. Nanda, P. C., *J. Indian bot. Soc.*, 1962, **41**, 271.
4. Pal, M., *Proc. Ind. Acad. Sci.*, 1964, **60**, 437.
5. Sharma, A. K. and Banik, M., *Bull. Bot. Soc. Bengal*, 1955, **19**, 40.
6. Willis, J. C., *A Dictionary of the Flowering Plants and Ferns*, 7th Ed., Cambridge Univ. Press, **1966**.

CONTROL OF FRUIT-CRACKING IN PEAR

FRUITS of Conference variety of pear growing on hard clay, acidic soil with pH 5·8 to 6·1 were observed to be badly damaged due to fruit-cracking at the Government Gardens, Chaubattia. The severe cracking of fruits appeared in the above variety during 1968 but not in 1969 (*vide infra*). The symptoms were mainly noted on fruits and they appeared after fruit had attained some size. The crackings were shallow and deep in nature and formed a net-like structure on the surface of the fruit. The trees showing the fruit-cracking were generally stunted in growth and the fruits were small, hard, severely cracked with very rough skin. The cracking was preceded by browning of the tissue and, usually, depression on the fruits. No such symptoms were observed on the other varieties growing in the orchard.

A review of the literature showed that the main cause of these types of symptoms including blossom blast of flowers and buds in pear is boron deficiency (Bullock and Benson, 1948; Richi, 1958; Yataas, 1969). Bullock and Benson (1948) suggested 2 lb. borax per tree as the control of fruits cracking due to boron deficiency. Crompton (1957) could also check the fruit damage due to boron deficiency in Bartlett pear by the application of ½ lb. borax or 2 lb. per 100 gallons per tree sprays. Richi (1958) found the sprays of 0·5% borax very effective in checking the effect of boron deficiency in pear. Agrios (1967) suggested drought, nutrient deficiency and/or viruses as possible causes for net-like, ring-cracking in pear. Rom and Morris (1967) showed that application of sodium polyborate increased the yield, sugar, acidity and vitamin C content of apple sprayed with borax beside controlling boron deficiency in the tree.

TABLE I

Effect of borax sprays on fruit-cracking and juice quality in Conference pears

Treatments	Fruit characters (1969)				Chemical composition of fruits (1969)								
								Sugars %					
	% Cracked fruits	Average weight per fruit in gm.	Yield in kg.	% rise in yield over control	Moisture %	Acidity %	T.S.S. Brix°	Total	Reducing	Sucrose	True tannin %	Vitamin C mg./ 100 gm.
Control ..	90·00	137·660	5·500	..	81·5	0·353	8·50	5·04	4·80	0·24	0·698	2·740
0·1% borax ..	43·00	200·000	8·500	54·54	83·0	0·387	9·25	8·30	7·67	0·63	0·712	3·480
0·5% „ ..	Nil	263·000	13·750	150·00	84·0	0·450	10·50	8·36	7·80	0·56	0·658	4·480
1·0% „ ..	Nil	262·660	13·500	145·45	84·4	0·470	10·60	8·40	7·90	0·50	0·736	4·720

Sprays of different concentrations of borax were, therefore, tried on Conference variety of trees to control fruit-cracking during 1968–69. Foliar sprays of 0·1, 0·5 and 1·0% borax were applied twice after blossom on the affected trees.

Samples of the fruits were analysed before the commencement of the experiment and after spraying of borax. The results are given in Table I.

The cracking was eliminated in treated fruits due to addition of borax which might have accumulated more in the fruits than in leaves and resulted in removing of the malady (Fig. 1).

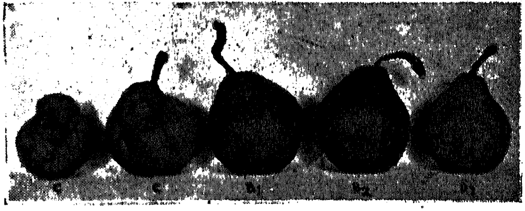


FIG. 1. Effect of borax sprays on the control of fruit-cracking in pear var. Conference. C—Control; B_1—0·1% borax; B_2—0·5% borax and B_3—1·0% borax.

The sprays of 0·5% borax were best among all the concentrations in eliminating the cracking, increasing the quality as well as yield of the fruits. The fruits in 0·5 and 1·0% borax sprays were having higher moisture content, T.S.S., total sugars and vitamin C. The fruits in these treatments were quite normal in appearance. Hence two sprays of borax (0·5%) after blossom are recommended for the control of such cracking in pear.

Thanks are due to Dr. S. K. Bose, Officer-in-Charge, for the valuable guidance and to Dr. J. N. Seth, Fruit and Vegetable Breeder, for going through the manuscript.

Govt. Hill Fruit
Research Station,
Chaubatti Distt., Almora (U.P.),
March 31, 1970.

S. D. DUBE.
C. B. RAM.

---

1. Agrios, G. N., *Phytopathology*, 1967, p. 801.
2. Bullock, R. M. and Benson, N. R., *Proc. Amer. Soc. hort. Sci.*, 1948, p. 51.
3. Crompton, O. C, *Boron on Oregon Pears. West Fruit Gr.*, 1957, **11** (10), 15 illus.
4. Richi, R., *Riv. Oxofloro Fruttie: ital*, 1958, **42**, 515.
5. Yataas, J., *Hort. Abs.*, 1969, **39** (1), 34.
6. Rom, R. C. and Morris, J. R., *Arkans. Fm. Res.*, 1967, **16** (2), 14.

REVIEWS AND NOTICES OF BOOKS

Annual Review of Physiology (Vol. 32). (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1970. Pp. ix – 636. Price post-paid: U.S.A. $ 10.00; Foreign: $ 10.50.

The thirty-second volume of the *Annual Review of Physiology* appears with its customary freight of the precious ore of physiology concentrated and refined in considerable degree.

The contents of this volume are: The Road A Scientist Followed: Notes of Japanese Physiology as I Myself Experienced it, by Genichi Kato; Transport Across Cell Membranes, by R. Whittam and K. P. Wheeler; Endocrine Regulation of Calcium Metabolism, by D. H. Copp: Skeletal Muscle, by Alexander Sandow; Digestion: Intestinal Secretion, by Thomas R Hendrix and Theodore M. Bayless; CNS at the Cellular Level: Identity of Transmitter Agents, by Catherine Hebb; The Functional Organization of Invertebrate Ganglia, by Eric R. Kandel and Irving Kupfermann; Central Pathways of Vision, by G. S. Brindley; Pain, by Robert K. S. Lim; Overall Regulation of the Circulation, by J. Alan Herd; Systemic Circulation: Local Control, by Stefan Mellander: Comparative Physiology: Chromatophores, by Milton Fingerman; Heart, by Matthew N. Levy and Robert M. Berne; Respiration, by Robert A. Mitchell; Reproduction, by David T. Armstrong; Comparative Physiology: Electric Organs, by Michael V. L. Bennett; The Lymphoid System, by R. A. Gatti, O. Stutman, and R. A. Good; The Regulation of Extracellular Fluid Volume; by Otto H. Gauer, James P. Henry, and Claus Behn; and Some Related Articles Appearing in Other *Annual Reviews*.

C. V. R.

Concepts and Models of Biomathematics (Vol. 1). Edited by F. Heinmets. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xi + 287. Price $ 16.75; £ 8.0 *sh.* 0 *d.*

Biochemical and physiological methodologies have been used primarily to study specific molecular processes or functional mechanisms. The usual result of such studies is isolation of a specific system and exploration of a limited number of interactions. Because of this, information gained by these methods has only limited value, and interpretation of these results in the framework of the total system is highly restricted. In order to understand the functional behaviour of the total system, the integration of information from various subsystems is essential. For this purpose model-systems can be developed. These must contain sufficient number of functional units and reveal interactions between these units so that functionally meaningful properties are exhibited by the model-systems.

This book contains an outstanding assembly of biological model-systems, which have been developed and analyzed by highly competent scientists using computer techniques. It not only presents an analysis of the subject-matter, but also gives detailed numerical data and the computer techniques used.

The chapters contained in this book are: 1. Simulation of Glycolytic Systems; 2. The Analysis of Electron Transport Kinetics in Mitochondria; 3. Fourier Transform Analysis of Tracer Data; 4. Blood Glucose Regulation and Diabetes; 5. Analysis of Cellular Growth Process; 5. Modelling of Adrenocortical Secretory Dynamics; 7. Simulating the Grazing Situation; and 8. A Model for Selection in Systems of Species Competition.

This book will be suitable as a text for quantitative biology courses. It will be useful to all scientists and students who want to develop an understanding of biological processes at a quantitative level, and thus gain a deeper and more penetrative understanding of nature. It will also help in designing more fruitful experiments and carrying out advanced research.

C. V. R.

Publications of the Information Centre on High Temperature Processes at the University of Leeds (England).

In 1966 a special panel of the Science Research Council, Great Britain, concluded that the field of high temperature processes merited special stimulation and development and consequently, the Council is now supporting a number of projects in this field. Two of these projects have been initiated in the University of Leeds. One of them is concerned with the establishment of an information centre on high temperature processes, and the other with the compilation of critically evaluated kinetic data for reactions of interest in high temperature processes.

We have received the following sample publications from the Centre: 1. *High Temperature Information Bulletin*, No. 15, March 1970, 25 pages. This Bulletin is published at bimonthly intervals and contains references to recently published work in the field of high temperature research. Annual Subscription £ 5, or $ 15.00. Information Centre of High Temperature Processes Department of Fuel Science, The University of Leeds, LS 2, 9 JT Yorkshire, England.

2. *High Temperature Reaction Data*, No. 2, November 1968, pages vi + 34. Department of Physical Chemistry, The University, Leeds 2, England. This report is the second of a series from the evaluation project. In it some homogeneous gas phase reactions involving hydrogen and oxygen have been evaluated. A separate section is devoted to each reaction and the order of material presented is as follows: (*i*) Thermodynamic data, (*ii*) Recommended value of rate constant, (*iii*) Arrhenius plot of available data, (*iv*) Table of available data, (*v*) Discussion, and (*vi*) References.

There is no doubt that these informative bulletins will be of value to all workers in the field of high temperature processes.

Cationic Surfactants. Edited by Eric Jungermann. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1970. Pp. 652. Price $ 37.50.

In recent years cationic surface active agents with antibacterial properties have been playing an increasingly important role in industry and science as sanitizing and antiseptic agents, as components in cosmetic formulations and as germicides and fungicides. New applications include their use as antistatic agents, textile softeners, corrosion inhibitors, foam depressants, flotation chemicals, asphalt and petroleum additives.

The book under review is volume 4 of the Surfactant Series brought out by Marcel Dekker, Inc. It gives a comprehensive up-to-date coverage of cationic surfactants. The contents are organized in four parts. Part I, in five chapters, covers the organic chemistry of cationic surfactants, including synthesis, applications, and physical properties. Part II, in six chapters, covers the physical chemistry of pure cationic surfactants and includes discussions of important theoretical aspects of colloid chemistry. Part III is a critical review of techniques for the identification and determination of cationic surfactants. The two chapters of Part IV are concerned with the germicidal and toxicological properties of cationic surfactants. Eighteen authors from Universities and Industry who are experts in this field of work have contributed to the fifteen chapters of the book. A. S. G.

Introduction to Physical Organic Chemistry. By R. D. Gilliom. (Addison-Wesley Publishing Co., Inc., West End House, 11, Hills Place, London W. 1, England), 1970. Pp. 342. Price 126 *sh.*

This book is designed for a one-semester course on physical organic chemistry to undergraduate seniors. It attempts to relate the two complementary approaches to the subject, namely, the empirical study of mechanisms of homogeneous organic reactions and the theoretical viewpoint. The material covers molecular orbital theory, chemical kinetics and applications, kinetic isotopic effects, linear free energy relationships and determination of reaction mechanisms. The last two chapters deal with electrophilic aromatic substitution, and nucleophilic substitution and elimination reactions at saturated carbon. The text includes recent advances in the subject, and suggested readings and references to literature are given at the end of each chapter. A. S. G.

Books Received

From: (Addison-Wesley Pub. Co., West End House, 11, Hills Place, London W. 1, England)

Calculus: A Short Course. By D. E. Richmond, 1970. Pp. xiv + 239. Price 70 *sh.*

Introduction to Mathematics. By F. M. Hudson and D. W. Adlong, 1970. Pp. 479. Price 91 *sh.*

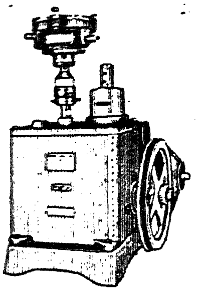
Physics. By M. Alonso and E. J. Finn, 1970. Pp. viii + 760. Price 89 *sh.*

Calculus and Statistics. By M. C. Gemignani, 1970. Pp. xi + 353. Price 63 *sh.*

Elementary Geometry. By V. H. Haag, C. E. Hardgrove and S. A. Hill, 1970. Pp. xi + 255. Price not given.

A First Course in Quantitative Analysis. By R. V. Brumblay, 1970. Pp. ix + 420. Price 65 *sh.*

2290-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, at The Bangalore Press, Bangalore-18.



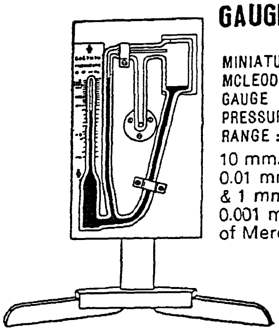
THE 'FINE FOUR' IN 'BASYNTH' RANGE !

ROTARY VACUUM PUMPS

OIL SEALED TYPE

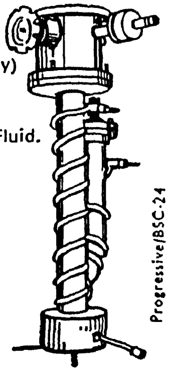
GUARANTEED ANALYTICAL REAGENT CHEMICALS

conforming to Internationally accepted specifications



VACUUM measuring **GAUGE**

MINIATURE MCLEOD GAUGE PRESSURE RANGE : 10 mm. to 0.01 mm. & 1 mm. to 0.001 mm. of Mercury.



OIL DIFFUSION PUMP

with Baffle Valve, By-pass Valves etc.

(All-metal Body)

VACUUM : 10^{-5} mm. Hg. with Basynth Fluid.

SPEED : 50 Litres/Sec. or more.

100% INDIAN

MANUFACTURED BY :

BASIC & SYNTHETIC CHEMICALS PRIVATE LTD.

25, EAST ROAD, JADAVPUR, CALCUTTA-32.

Progressive/BSC-24

JUST PUBLISHED

INDIAN THYSANOPTERA

By

T. N. ANANTHAKRISHNAN, Director, Entomology Research Unit, Loyola College, MADRAS

The first in the zoological monograph series published by the Publications & Information Directorate, CSIR, the monograph contains a detailed study of insects belonging to the Order Thysanoptera, commonly called thrips. More than 400 species belonging to about 200 different genera are covered.

The bionomics, taxonomy, morphology, reproduction and development and structural diversity of thrips and their role as pests in agriculture and horticulture are dealt with. An appendix listing all Indian species and an exhaustive bibliography containing 345 references are valuable additions.

Of use to students, teachers and research workers.

Pages viii + 171, royal 8 vo. 10 Plates and 38 text illustrations

Price : Rs. 26·00 ; Sh. 52 ; $ 8.00

Can be had from

Sales & Distribution Section

Publications & Information Directorate, CSIR

Hill side Road, New Delhi-12

STUDY OF SEDIMENT MOVEMENT BY FLUORESCENT TRACERS AT HALDIA ANCHORAGE*

H. N. SIDDIQUIE AND P. C. SHRIVASTAVA

Marine Geology Unit, Geological Survey of India, Calcutta-13

ABSTRACT

A new and simple technique for preparation of bulk tracer samples based on varnishing sand with fluorescent dye (rhodamine) is described. An investigation of sediment movement using tracer prepared by this method was carried out at the Haldia anchorage in the Hooghly river. The fine sand sized tracer conforming to the sediment size at the Haldia anchorage was released at low water and its movement was traced with rising tide. An analysis of the tracer distribution pattern indicates that the predominant direction of movement is towards north-east and a probable subsidiary direction towards north. The former probably represents the direction of movement of sand and the latter the direction of fine sediments. The observed grain velocities range from 4·5 to 10·3 m./min., and the depletion rate 19·9 and 8·1 kg./min. for 50 and 120 minutes. These indicate the large transporting capacity of the flood tide

INTRODUCTION

FLUORESCENT tracers are increasingly being used to study the sediment movement in lacustrine, fluvial and shelf areas (*cf.* Zenkovich,[1] Aibulatov,[2] Ingle,[3] Seibold[4]). The studies are of considerable significance for problems of coastal engineering, especially in problems relating to harbour designs. In India, Gole[5] carried out a fluorescent tracer investigation at Mangalore and later some studies were also carried out by the Hydraulics Study Department of the Calcutta Port in the Hooghly river.

Present investigation.—The area of investigation is situated just north of the confluence of the Haldia river with the Hooghly (22° 0′ 42″ : 88° 4′ 12″). The Hooghly river below the Balari bar widens and the Nayachara island splits the channel into the eastern and western. The eastern channel with a large number of bars is largely silted; while the western channel is relatively deeper and is used for navigation. The western channel is about 3·5 km. wide, but most of it is shallow. The navigable part of the channel, mainly along the north-western bank and generally 8–10 m. deep and at places approaching 12 m., is about 500 m. wide. On the south-eastern side of the channel the depths are shallow, of the order of 3–5 m., and this defines the shoal which is marked by the Nayachara buoy.

The present studies form part of a large programme of studies of problems of coastal erosion and deposition undertaken by the Geological Survey of India. The fluorescent tracer investigation of the sediment movement on the Hooghly bars was taken up under this programme as the results of the studies are likely to be useful in the future planning and development of Haldia and Calcutta Ports.

The sediments in the area of investigation range from clay and silt to silty sand and fine sand. The shoal itself consists of fine sand which grades to a silty sand on the western side and farther in the deeper portions in the Haldia channel the sediments are mainly silt and clay. The records of surface and bottom current velocities maintained by the Hydraulics Study Department show that velocities range upto 225 cm./sec. and 195 cm./sec. respectively. The direction of surface and bottom currents at flood tide varies from 30° to 65° and 60° to 340° respectively. The tidal range at the time of investigation was about 3 m.

METHOD

Preparation of bulk tracer sample.—The authors have devised an improved technique for the preparation of bulk tracer sample. Fluorescent dye, Rhodamine B 500, is mixed with binders, Necol clear varnish and Duco thinner. Sand in lots is added to this mixture and mixed thoroughly to give a proper coating to all grains. Dyed sand is then dried. Mixtures of dyed and undyed sands were stirred in fresh and saline water in a laboratory stirrer for periods ranging from 1–12 hours to evaluate the performance of the tracer. The laboratory trials and later field studies indicated that the coating is durable. The technique obviates the need of baking sand at high temperatures and obviates the use of hazardous liquids. The method therefore appears simpler than those used by earlier workers and reported by Ingle.[3] The cost of preparation of tracer is around Rs. 1·40 per kg. and is, therefore, cheaper than the other methods reported by Ingle.[3] Thus the technique in suitable environments is much cheaper than radioactive tracers.

---

* Published with the kind permission of the Director-General, Geological Survey of India.

Release of tracer; sample collection and scanning.—The tracer was released at low water between 11·00 and 11·20 hrs. on 7-1-1968 and the movement was traced with rising tide. Twenty minutes after releasing, bottom samples were collected with a small Dutch or Van Veen Grab (area 120 cm.^{2}) first in a square pattern roughly at 300 metres around the release point. When the preliminary scanning of the samples indicated mainly northward movement of tracer particles two more traverses at 600 and 1,000 metres were made further north of the earlier grid perpendicular to the inferred direction of movement (Fig. 1). The bottom samples collected in the field were washed with freshwater to remove salts and dried. The entire samples were spread as a "one grain layer" and scanned under an ultraviolet lamp and the number of fluorescent grains counted.

RESULTS OF THE INVESTIGATION

Tracer distribution patterns and the direction of sediment movement.—The tracer distribution patterns were prepared using the absolute values of tracer concentration in samples as also by applying correction for a standard elapsed time expressing tracer concentration in square centimetre (Fig. 2). The fluorescent tracer grains were traced to a maximum distance of 1,060 meters. The distribution pattern for the absolute values of the tracer grains shows the major concentration to be localised in the vicinity of the release point, the highest concentration (> 500) being in sample No. 20, which is located just north-east of the release point. The next higher concentration value (> 200) is located in the extreme north-east at station No. 38. The disposition of the contour for 100 and the higher values at station No. 38 show that the predominant direction of movement of sediments is towards north-east with a subsidiary movement to the north. The major direction of movement towards the north-east is mainly along a line across coarser sediments, while the subsidiary direction of movement to the north lies across an area covered by finer sediments. This probably indicates that sand is moving north-east and the finer material, silt and clay, is moving towards the north. It is also likely that the clay is moving towards the north-east but due to differences in the energy environments it is flocculated and deposited in the channel towards the north. Perhaps this clayey material cannot be deposited in the turbulent conditions on the shoal and is carried farther north-east beyond the sampled area. It is clear from the plotted tracks of the inferred direction of movement that in the later stages there has been an easterly veering of the direction of movement of sediments. This is indicative of changes in current direction during the later period of investigation.

Grain velocities.—Grain velocities were calculated from the observed distance travelled along the mean path of transport divided by the elapsed time between the release of tracer and arrival at a known point. The velocities for sand range from 4·5 to 5·3 m./min. and for silt and clay from 4·8 to 6·1 m./min. for the first and second sets of samples respectively. The maximum observed grain velocities for the first and second sets are 10·3 and 6·1 m./min. respectively. The observed grain velocities are about 1/2 to 1/3 of the reported current velocities.

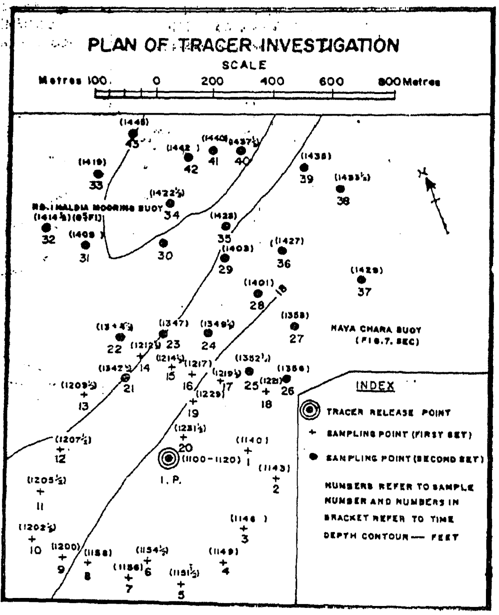

PLAN OF TRACER INVESTIGATION
SCALE
Metres 100 0 200 400 600 800 Metres
RD. I HALDIA MOORING BUOY (85 FI)
HAYA CHARA BUOY (FI 6.7. SEC)
I. P.
(1100-1120)
INDEX
TRACER RELEASE POINT
SAMPLING POINT (FIRST SET)
SAMPLING POINT (SECOND SET)
NUMBERS REFER TO SAMPLE NUMBER AND NUMBERS IN BRACKET REFER TO TIME
DEPTH CONTOUR — FEET

FIG. 1

Depletion rate.—The rate in kilogram of the fluorescent tracer leaving the sampled grid per minute is termed the depletion rate. The tracer depletion rate was calculated by Ingle's[3] method converting the quantity of tracer released to number of grains and a planimetric estimation of the total number of grains present in the sampled grid at a parti-

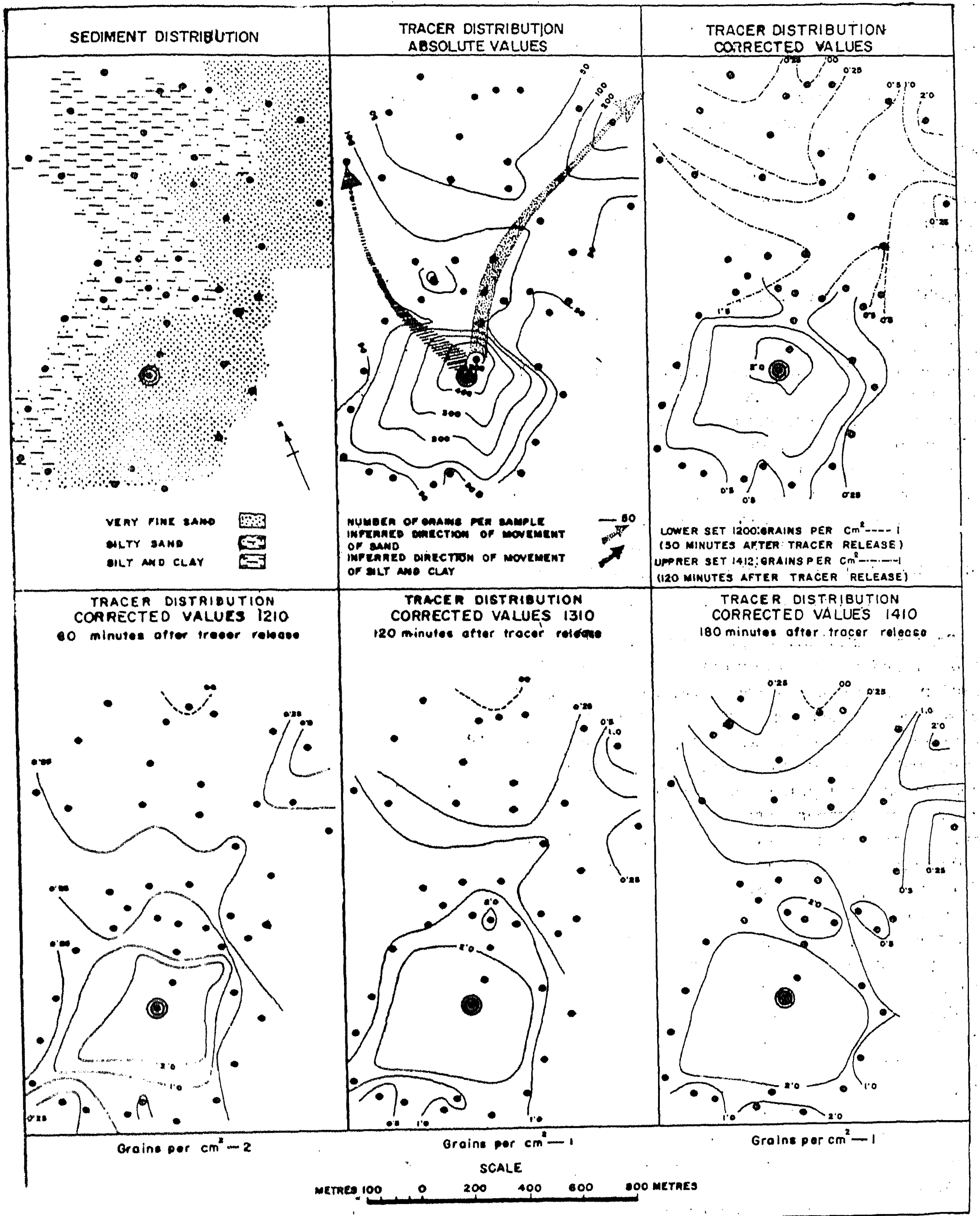

SEDIMENT DISTRIBUTION
TRACER DISTRIBUTION ABSOLUTE VALUES
TRACER DISTRIBUTION CORRECTED VALUES
VERY FINE SAND
SILTY SAND
SILT AND CLAY
NUMBER OF GRAINS PER SAMPLE — 50
INFERRED DIRECTION OF MOVEMENT OF SAND
INFERRED DIRECTION OF MOVEMENT OF SILT AND CLAY
50
100
200
300
400
800
LOWER SET 1200:GRAINS PER Cm² ---- I
(50 MINUTES AFTER TRACER RELEASE)
UPPER SET 1412:GRAINS PER Cm² —·—·— I
(120 MINUTES AFTER TRACER RELEASE)
0·25
0·5
1·0
2·0
TRACER DISTRIBUTION CORRECTED VALUES 1210
60 minutes after tracer release
TRACER DISTRIBUTION CORRECTED VALUES 1310
120 minutes after tracer release
TRACER DISTRIBUTION CORRECTED VALUES 1410
180 minutes after tracer release
Grains per cm² — 2
Grains per cm² — I
Grains per cm² — I
SCALE
METRES 100 0 200 400 600 800 METRES

FIG. 2

cular standard elapsed time (Fig. 2). The computed depletion rates for the present investigation are given below.

Approximate number of grains in 1 gm. of tracer = 3,90,000 (average 4 counts). Approximate number of grains in 1 tonne of tracer = 3,900 × 10^8. Total number of grains remaining in the sample grid after 50 minutes = 28 × 10^8 or 0·7% of the grains released. Thus the total number of grains lost from the sampled grid in the first 50 minutes = 3,872 × 10^8 or say 992·8 kg. or 19·9 kg./min. Similarly the depletion rate for the first 120 minutes is 8·1 kg./min.

CONCLUSIONS

The results of the fluorescent tracer investigation at Haldia anchorage indicate that at flood tide the predominant direction of movement is towards the north-east and a probable subsidiary direction towards the north. The former probably represents the direction of movement of sand and the latter the direction of movement of finer sediments, *i.e.*, silt and clay. Further studies, with bicoloured tracers of two different sizes, are planned to confirm this observation. The fluorescent grains were traced to a maximum distance of over one kilometre and the observed grain velocities range from 4·5 to 10·3 m./min. and are roughly 1/3 to 1/2 of the observed bed current velocities. The computed depletion rate of 19·9 and 8·1 kg./min. for the first 50 and 120 minutes indicate the large transporting capacity of the flood tide.

ACKNOWLEDGEMENTS

The authors thank the Commissioners for the Port of Calcutta for providing facilities on the *RV Anusandhani* for the investigation†; Dr. S. K. Bhattacharya, Chief Engineer, Hydraulics Study Department, for his keen interest in the investigation; Shri G. S. Paul, River Research Officer and Capt. H. C. Malhotra, Commander of *RV Anusandhani*.

The programme of fluorescent tracer investigation of sediment movement was taken up mainly due to the keen interest evinced by Shri G. C. Chaterji, Director-General and Shri C. Karunakaran, Deputy Director-General, Geological Survey of India, to whom the authors are particularly grateful.

---

† The opinions expressed in the paper are those of the authors and not of the Commissioners.

1. Zenkovich, V. P., "Osnovi ucheniya razvetiye beregov (Basic studies on the development of marine coasts)," *Acad. Sci. USSR*, Moscow, 1962, p. 1.
2. Aibulatov, N. A., "Issleduvaniye vodolberegovo peremesheniya pecchanikh nanocov more (Investigation of along shore movement of sand drifts in the sea)," *Nauka*, Moscow, 1966 p. 157.
3. Ingle, James C., *The Movement of Beach Sand*, Elsevier Publishing Co., Amsterdam, 1966, p. 1.
4. Seibold, E., "Geological investigation of nearshore sand transport," in M. Sears (Ed.), *Progress in Oceanography*, Pergamon Press, New York, 1963, p. 1.
5. Gole, C. V., "Fluorescent tracer study at Mangalore Port," *Inter. Assoc. Hydraulic Res. Cong.*, *10th.*, *London*, 1963, 1, 275.

SOME RECENT STUDIES ON THE RESTORATION OF PERMEABILITY TO WATER OF SOILS RENDERED IMPERMEABLE EARLIER BY THE SWELLING ACTION OF SOIL COLLOIDS BY SODIUM CARBONATE

L. A. RAMDAS

Scientist Emeritus, National Physical Laboratory, New Delhi

ABSTRACT

When the lower end of a column of soil packed in a glass tube is dipped in a 2% solution of sodium carbonate, it develops an impervious stratum at the bottom instantaneously and no capillary ascent takes place even after 30 days. In a similar soil column dipped in water, the water ascends rapidly, completing a capillary rise of 70 cm. within 23 days. A series of soil tubes initially rendered impermeable by dipping in sodium carbonate solution are later transferred to solutions of ammonium chloride, bromide, nitrate, sulphate and phosphate and of calcium, strontium and barium chlorides respectively. Within a short time, these solutions destroy the impermeable strata and resume capillary ascent with varying rapidity. Such restoration of permeability has immense potentiality for use in reclaiming the "alkali-ridden" soils of India.

1. INTRODUCTION

THE movement of liquid water through a porous medium like the soil is of fundamental interest in Soil Physics as well as of immense practical importance to agriculture. While developing and directing the programme of research in Agricultural Meteorology at Poona (1932–1956), the present writer and collaborators had conducted extensive studies on many aspects of this topic. The results then obtained have been discussed in a series of published papers[1–18] and reviewed in a paper entitled "The movement of moisture through the soil".[14]

Recently, on being invited to a Symposium on "Reclamation and Use of Waste-lands in India" held in Delhi in 1968, my interest in this problem was revived and some fresh investigations were carried out. The results obtained are discussed in the present paper.

2. REVIEW OF EARLIER EXPERIMENTS

While studying the movement of water through a soil column one has to reckon also with salts that may be present in the soil medium, occurring naturally or deliberately added. These dissolve in the water while it moves (*a*) *downwards* as percolation or (*b*) *upwards* by capillary ascent. It was observed that alkalies like sodium hydroxide, acids like dilute sulphuric acid, hydrochloric acid or nitric acid as well as their salts like sodium sulphate, sodium chloride or sodium nitrate, etc., if present in the soil as aqueous solutions, do not affect either the permeability or the rate of movement of water through the porous medium, although their presence will not be tolerated by living plants that may be growing on the soil. It was, however, noticed in the very earliest experiments that the presence of a trace (up to 2% or so) of *sodium or lithium carbonate* produces a dramatic change in the permeability of the soil; *these carbonates make the soil absolutely impervious to water.* This effect was soon traced to the swelling of the soil colloids which choke up the pore spaces between the soil particles. Some of the earlier experiments also suggested that under the influence of the sodium carbonate molecule a kind of semi-permeable coating is formed around each of the swelling particles and that the swelling is an osmotic effect. It was also found that when a 'swelled' soil is later treated with a solution of calcium, strontium or barium chloride, the 'soil-sodium-carbonate' complex causing swelling is destroyed permanently by the formation of insoluble calcium carbonate (or barium or strontium carbonate as the case may be) resulting in a permanent restoration of the permeability to water as verified by a series of percolation experiments. Obviously, the remaining salts being all soluble in water, they are easy to wash away by liberal doses of water at the top of the soil column (*i.e.*, heavy irrigation).

In passing, it may be stressed that we are fortunate that lithium carbonate which causes much more swelling than sodium carbonate is less abundant on the soil crust of the earth than the sodium carbonate; the latter, however, causes, as we have already remarked, sufficient swelling to bring about the impermeability condition in the soil column. Under natural or field conditions, in an arid zone there may be some sodium carbonate lying safely some feet below the surface. When such an area is suddenly brought under generous irrigation, as happened in the Punjab and adjoining areas after the turn of the present century, during intervals between the periodic irrigation when the water begins to ascend by capillary action, the salts dissolved in the irrigation water are also brought up through the upper layers of the soil towards the drying surface. Should an impervious layer form at any depth below the surface by the swelling action of sodium carbonate, a stage is soon reached when any water fed to the surface either as rain or irrigation water, it simply refuses to percolate and this leads to the well-known water-logging characteristic of what is designated as alakali-ridden tracts, of which there are now many millions of acres in N.W. India. Also, any subsoil water below the impervious layer is unable to come up to the surface. The experiments we have been conducting, though on a small laboratory scale, have therefore a large-scale potentiality for reclaiming such areas that have become unfit for agriculture.

3. PRESENT EXPERIMENTS

In our present experiments we adopt the simple technique of capillary ascent through soil columns packed in glass tubes dipping at the bottom into reservoirs of water or the several solutions used for testing their permeability. These experiments have been performed with the well-known black cotton soil of the Bombay Deccan which has a high clay-content. After air-drying, the coarser particles are removed by passing through a 1 mm. sieve. The glass tubes used are about 1 metre long with an internal diameter of 1·4 cm. with their lower end closed by stretching clean muslin pieces and tying them up with string. The soil is packed in a uniform manner by the technique of tapping described in one of our earlier papers.[5] Having prepared a sufficient number of soil-packed tubes (we shall refer to them hereafter as soil tubes), they are clamped in a vertical position and their lower ends dipped into water or the several solutions of salts as desired (*see* Fig. 1).

While one of the soil tubes was kept in water and the daily rate of rise of the capillary fringe [illegible] the other soil tubes were kept immersed in separate reservoirs containing [illegible] solution of sodium carbonate. The ascent of water in the first tube proceeded rapidly at the normal rate and attained a height of 70 cm. within 23 days after start. In all the other soil tubes no ascent at all was noticed even after 30 days, showing that in all of them the capillary ascent has been completely inhibited by the formation of an impervious stratum at the bottom of the soil columns. When one of these impervious tubes was kept immersed, as in Fig. 1, in water, there was no ascent at all even after another 30 days.

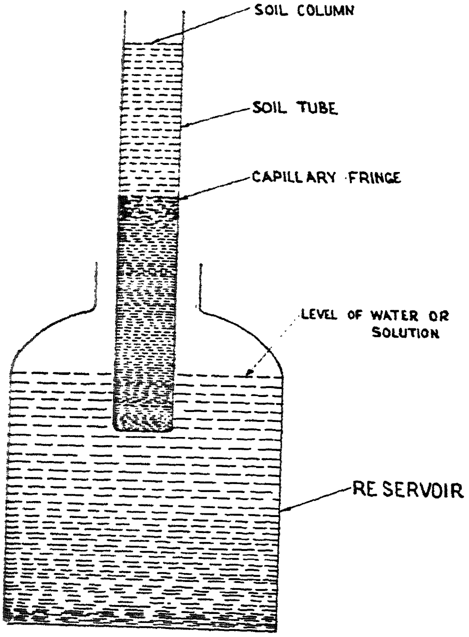


FIG. 1

The other impervious soil tubes were transferred separately into reservoirs containing 2% solutions of the following compounds:

Ammonium chloride; Ammonium nitrate; Ammonium bromide; Ammonium sulphate; Ammonium phosphate; Barium chloride; Strontium chloride; and Calcium chloride.

From the time of their immersion in the respective reservoirs containing the solutions referred to above, daily observations were recorded of the height of the capillary fringe as it continued to ascend in the soil columns. The daily upward movement of the capillary fringes in the different tubes are shown by the curves marked B, C, D, E, F, G, H and I respectively, in Fig. 2. The absence of any capillary ascent in these tubes in the first month when they had initially been immersed in solutions of sodium carbonate is indicated in Fig. 2 by the line marked KL along the horizontal axis. For comparison with these curves in the case of the different solutions, curve A shows the capillary ascent of pure water in the soil tube kept in water.

4. DISCUSSION OF RESULTS

Curve A shows the normal capillary rise of pure water in the black cotton soil. The capillary rise is quite rapid in the early stages and slows down gradually in the manner shown by curve A. The height of 70 cm. (this was the height of the soil columns packed in all the tubes) was attained within 23 days. As regards the other tubes, the complete absence of any capillary rise while they had been immersed in sodium carbonate solution, as shown by the line KL in Fig. 2, has already been referred to. On later being transferred into the various solutions referred to, after a few hours needed for these solutions to destroy the impervious strata at the bottom of the respective soil columns, the capillary rise commences and proceeds with varying speeds, depending on the particular substance. The solutions of the three salts of ammonium, *viz.*, ammonium chloride, ammonium nitrate and ammonium bromide show the most spectacular capillary rise, their speeds being in the order in which the substances are mentioned above. They all complete the maximum rise of 70 cm. within an interval of just 20 days. The barium chloride and the strontium chloride solutions are almost as speedy as ammonium nitrate or bromide in completing the entire rise of 70 cm. within 30 and 32 days respectively. Calcium chloride solution acts somewhat more slowly, taking an interval of 66 days to rise to the top of the soil column. Finally, we have the two other ammonium salts, *viz.*, ammonium sulphate and ammonium phosphate which show a less rapid rise as compared to the other salts we have mentioned. Earlier results based on percolation rates have already shown that the restoration of permeability in the case of the chlorides of the alkaline earths is permanent. The rapid rise of the ammonium salts shown by curves B, C and D is very interesting and we have still to verify whether they will subsequently retain the permeability when water is later substituted for the solutions. All the soil tubes are at present available for fur-

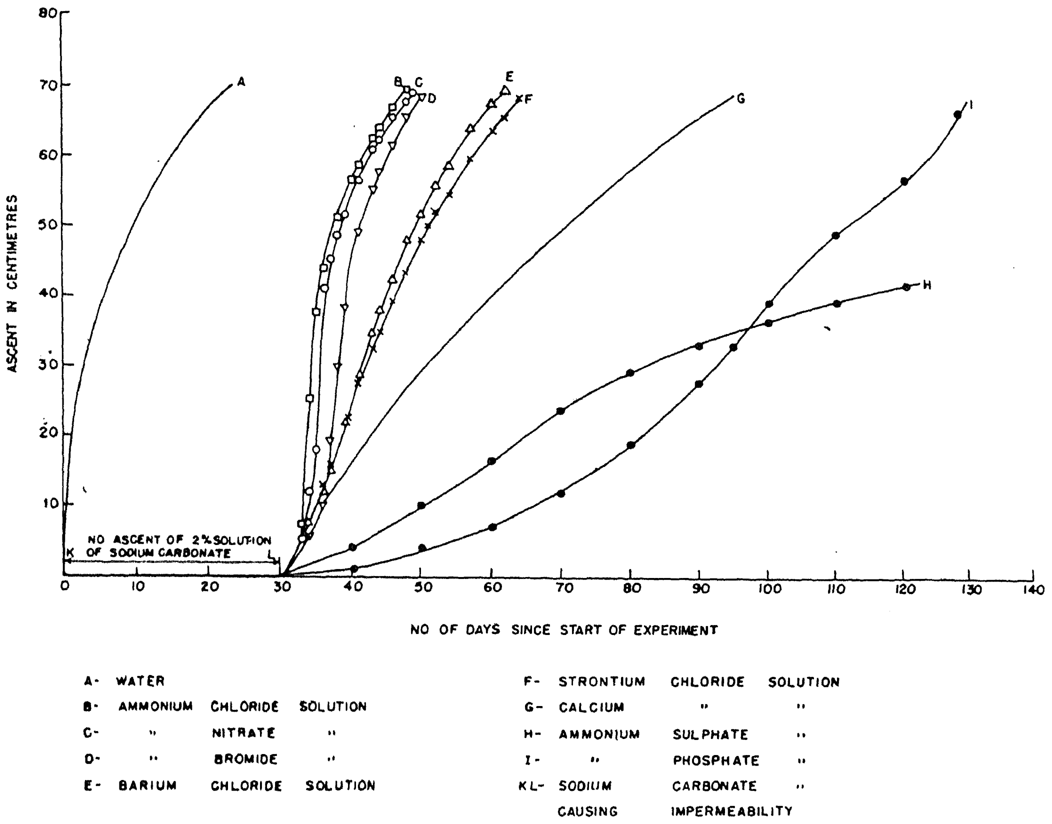


FIG. 2. Ascent of water and of various aqueous solutions through the black cotton soil.

ther experiments to test their subsequent permeability to draining (*i.e.*, percolation downwards). This phase of the investigation is now under way.

5. CONCLUDING REMARKS

In conclusion one observes that very striking and useful results have been obtained with the very simplest of techniques. The present writer hopes to discuss further results on this problem in the near future as soon as the remaining experiments are completed.

Thanks are due to the authorities of the National Physical Laboratory for providing all facilities.

---

1. Ramdas, L. A. and Mallik, A. K., *Curr. Sci.*, 1939, **8** (6).
2. Mallik, A. K., *Ind. Jour. Agric. Sci.*, **1942**, **12**, Pt. 4.
3. Ramdas, L. A., Mallik, A. K. and Pandit, U. P., *Curr. Sci.*, July 1942.
4. Sreenivasan, P. S., *Ibid.*, July 1942.
5. Ramdas, L. A. and Mallik, A. K., *Proc. Ind. Acad. Sci.* Part I of paper. 1942, **16** (1), 1.
6. — and —, *Ibid.*, Part II of paper, 1942, **16** (1), 16.
7. — and —, *Curr. Sci.*, February 1944.
8. Momin, A. U., *Proc. Ind. Acad. Sci.*, April 1947, **17**, 2.
9. Ramdas, L. A. and Mallik, A. K., *Curr. Sci.*, June 1947.
10. — and —, *Proc. Ind. Acad. Sci.*, 1947, **26**.
11. Katti, P. K., *Ibid.*, 1949, **29**.
12. Ramdas, L. A., *Jour. of CSIR.*, 1949, **3** (1).
13. Katti. P. K., *CBI Jour.*, 1948.
14. Ramdas, L. A., *Proc. Symposium on Ground Water.* Publn. No. 4, Central Board of Geophysics, 1955.

OIL-BODIES IN INDIAN LIVERWORTS

RAM UDAR, S. C. SRIVASTAVA AND DINESH KUMAR
Department of Botany, University of Lucknow, Lucknow, India

IN recent years, the study of oil-bodies in liverworts, particularly in foliose forms, has gained considerable attention in other countries (Müller, 1939; Hattori, 1951, 1953; Schuster and Hattori, 1954; Schuster, 1966; Inoue, 1967). In India, however, no attempt has been made so far towards this aspect of study. Since the oil-bodies are considerably significant in the taxonomy of leafy liverworts, an attempt is being made to present their details in the liverworts growing in the country.

The oil-bodies can be successfully studied only from living plants. It has been observed that herbarium specimens examined after 6 months or a year of storage from the date of collection invariably do not show the presence of oil-bodies. However, in some species they seem to be retained even for over a year or so. In Marchantiales and Metzgeriales oil-bodies are almost absent except in few genera. In a majority of Jungermanniales and Calobryales oil-bodies are prominently present. An account of oil-bodies in 10 species of leafy liverworts, collected by the authors from Darjeeling (Eastern Himalayas) during the month of December 1969 and January 1970, has been given. The observations recorded in the present work were taken within one month after the date of collection.

1. *Plagiochila himalayensis* Schffn. (Fig. 1). —The oil-bodies are 3–7 per cell in the middle, 2–5 at the margins and at the base of the leaf. They are spindle-shaped, 5·76–11·52 (15·84) μ long, granules obscure, smooth in outline with a prominent granular projection in the middle.

2. *Scapania parva* St. (Fig. 2).—The oil-bodies are 2–5 per cell in the middle, at the margins and at the base of the leaf. They are globose to sub-globose, 2·47–7·2 μ long, more or less smooth in outline, containing minute granules.

3. *Radula complanata* (L.) Dum. (Fig. 3). —The oil-bodies are usually 1(–2) per leaf cell; when the number is two, one oil-body is much smaller than the other, the latter occupies most of the area of the cell lumen. They are usually elongated or oblong, 5·76–20·16 μ long, somewhat irregular in outline, containing prominent granules.

4. *Radula campanigera* Mont. (Fig. 4).—The oil-bodies are usually 2 in each leaf cell with one small (rarely two) and one much larger. Sometimes only one large oil-body may be seen. They are spherical or globose, 3·46–15·36(–19·2) μ in diameter, more or less smooth or irregular in outline, containing prominent granules.

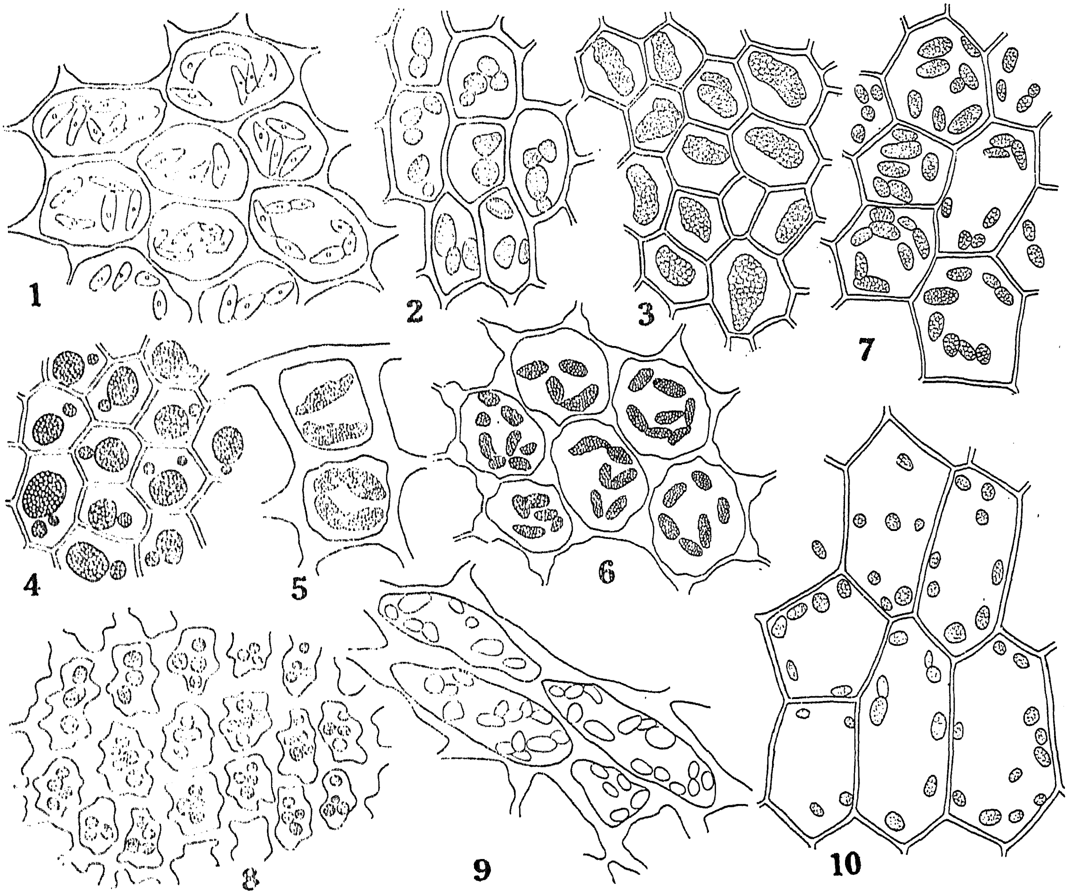
5. *Notoscyphus lutescens* (L. et L.) Mitt. (Fig. 5).—The oil-bodies are usually 2(–3) in each cell at the margin and 2–4 in the middle and basal cells of the leaf. They are elliptical or spindle-shaped, elongated, about 9·6–19·2 μ long, irregular in outline, containing prominent granules.

6. *Frullania retusa* Mitt. (Fig. 6).—The oil-bodies vary from 4–8 in each cell of the leaf. They are usually elliptical or spindle-shaped, rarely somewhat spherical or sub-globose, 3·36–7·68 (–9·6) μ long, more or less irregular in outline, containing prominent granules.

7. *Cephalozia gollani* St. (Fig. 7).—The oil-bodies vary from 6–8 in each cell of the leaf. They may be globose to sub-globose or even sometimes elongated, 2·4–11·52 (–14·52) μ long somewhat smooth in outline containing conspicuous granules.

8. *Chandonanthus hirtellus* (Web.) Mitt. (Fig. 8).—The oil-bodies vary from 3–5 in each cell of the leaf. They are usually spherical or globose, rarely sub-globose, 2·4–5·28 (–6·24) μ in diameter, more or less smooth in outline, containing granules.

9. *Herberta sikkimensis* St. (Fig. 9).—The oil-bodies vary from 5–14 in each cell of the leaf depending on the size, usually more in the cells of the vitta which are considerably larger in size than the other cells of the leaf. They are sub-globose or slightly elongated,



FIGS. 1–10. Fig 1. *Plagiochila himalayensis* Schffn., × 540. Fig. 2. *Scapania parva* St., × 540. Fig. 3. *Radula complanata* (L.) Dum., × 540. Fig. 4. *Radula campanigera* Mont.. × 540. Fig. 5. *Notoscyphus lutescens* (L. et L.) Mitt., × 540. Fig. 6. *Frullania retusa* Mitt., × 540. Fig. 7. *Cephalozia gollani* St., × 540. Fig. 8. *Chandonanthus hirtellus* (Web.) Mitt., × 510. Fig. 9. *Herberta sikkimensis* St., × 510. Fig. 10. *Lophocolea bidentata* (L.) Dum, × 540.

2·4–9·6(–11·52)μ long, smooth in outline, granules obscure or homogeneous.

10. *Lophocolea bidentata* (L.) Dum. (Fig. 10).—The oil-bodies vary from 4–8(–11) in each cell of the leaf. They are globose to subglobose, sometimes elongated, 2·4–7·2 (–9·6)μ long, smooth in outline, containing granules.

The present paper constitutes the first Indian contribution solely on the structure of oil-bodies in leafy liverworts.

1. Hattori, S., "Oil-bodies of Japanese Hepaticæ (1)," *Jour. Hattori, Bot. Lab.*, 1951, **5**, 69.
2. —, "Oil-bodies of Japanese Hepaticae (2)," *Ibid.*, 1953, **10**, 63.
3. Inoue, H., "Studies on oil-bodies of some Malayan liverworts," *Ibid.*, 1967, **30**, 54.
4. Müller, K., "Untersuchungen über die Ölkörper der Lebermoose," *Ber. Deutsch. Bot. Gesell.*, 1939, **57**, 325.
5. Schuster, R. M., *The Hepaticæ and Anthocerotæ of North America*, Columbia Univ. Press, New York, 1966, **1**.
6. — and Hattori, S., "The oil-bodies of the Hepaticæ II, The Lejeuneaceae," *Jour. Hattori Bot. Lab.*, 1954, **11**, 11.

LETTERS TO THE EDITOR

A SUSPECTED CONVERSE OF A THEOREM REGARDING SPHERICALLY SYMMETRIC SPACE-TIMES

Prasanna[1] has shown that, for the spherically symmetric metric,

$$ds^2 = -A\,dr^2 - B\,d\Omega^2 + C\,dt^2, \qquad (1)$$

where

$$d\Omega^2 = d\theta^2 + \sin^2\theta\,d\phi^2$$

and A, B, C are functions of r and t, the quantity

$$\frac{f_1 f_4 - f_5^2}{f_2 f_3} = I \quad (f_2 \neq 0,\ f_3 \neq 0) \qquad (2)$$

is an invariant under arbitrary non-singular Gaussian transformations preserving spherical symmetry.

The following problem has arisen from the same note and the notations of the same note are followed.

It is well-known that a necessary and sufficient condition for the metric (1) to be of class one is that

$$I = 1, \text{ i.e., } f_1 f_4 - f_2 f_3 = f_5^2. \qquad (3)$$

If (1) describes a perfect fluid distribution, the components of the curvature tensor R_{hij} satisfy the condition

$$\left(\frac{f_1}{A} - \frac{f_4}{C}\right)^2 - \left(\frac{f_2 B}{AC} - \frac{f_3}{B}\right)^2 = \frac{4f_5^2}{AC}. \qquad (4)$$

If (1) is of class one and it also describes a perfect fluid distribution, (3) and (4) imply either,

$$\frac{f_1}{A} - \frac{f_4}{C} = -\frac{f_2 B}{AC} - \frac{f_3}{B}, \qquad (5)$$

or

$$\frac{f_1}{A} - \frac{f_4}{C} = \frac{f_2 B}{AC} - \frac{f_3}{B}. \qquad (6)$$

The condition (5) is necessary and sufficient for the metric (1) to be conformally flat. Condition (6) has to be interpreted.

A spherically symmetric, conformally flat metric, describing a perfect fluid distribution, is necessarily of class one. This can be verified by imposing (5) on (4).

I understand from Prof. V. V. Narlikar that Dr. P. C. Vaidya had raised the question whether the converse of the above result holds good: that is, is a spherically symmetric metric of class one, giving a perfect fluid distribution necessarily conformally flat?

We give here a metric which shows that the converse does not hold good. The metric is,

$$ds^2 = -\frac{2r^2 + P}{r^2 + P}\,dr^2 - r^2\,d\Omega^2 + \frac{r^2 + P}{4K}\,dt^2, \qquad (7)$$

where P and K are arbitrary positive constants.

For this metric the surviving components of the curvature tensor are,

$$R_{1212} \equiv R_{1313}/\sin^2\theta \equiv f_1$$

$$= -\frac{r^2 P}{(2r^2 + P)(r^2 + P)},$$

$$R_{1414} \equiv f_2$$

$$= -\frac{P}{4K\,(2r^2 + P)},$$

$$R_{2323}/\sin^2\theta \equiv f_3$$

$$= -\frac{r^4}{(2r^2 + P)},$$

$$R_{2424} \equiv R_{3434}/\sin^2\theta \equiv f_4$$

$$= -\frac{r^2}{4K}\,\frac{(r^2 + P)}{(2r^2 + P)},$$

$$R_{1224} \equiv R_{1334}/\sin^2\theta \equiv f_5 = 0. \qquad (8)$$

The expressions for the pressure and density are,

$$8\pi p = \frac{1}{(2r^2 + P)},$$

$$8\pi\rho = \frac{2r^2 + 3P}{(2r^2 + P)^2}. \qquad (9)$$

It can be verified that (7) satisfies (3) and (4). It does not satisfy (5) but it satisfies (6).

Hence it can be safely said that, a spherically symmeric metric of class one, describing a perfect fluid distribution, is either conformally flat or it satisfies (6), and so the converse does not hold good in general. (7) is a new metric with interesting features. It satisfies the condition (6) which arises as an alternative to (5). Our interest here is mainly in demonstrating that a suspected converse does not hold good.

I wish to thank Prof. V. V. Narlikar, Lokamanya Tilak Professor of Applied Mathematics, University of Poona, for suggesting me this investigation and for his valuable guidance in preparing this note. I also wish to thank the U.G.C. for the award of a Research Scholarship which has made this work possible.

University of Poona, R. S. Tikekar.
Poona, *June* 4, 1970.

---

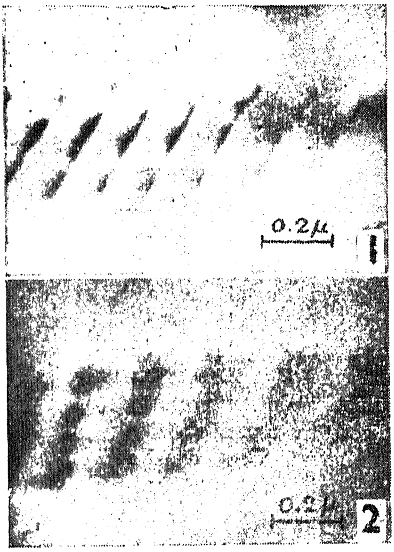
1. Prasanna, A. R., *Curr. Sci.*, 1969, **38**, 455.

ON THE FORMATION OF DISLOCATION LOOPS IN GADOLINIUM

Electron-microscope observations of the formation of dislocation loops in basal oriented thin single crystal film of h.c.p. metal gadolinium have been made. Evidence and arguments are advanced to show that the loops are formed as a result of the interaction between vacancies and dislocations.

Basal oriented Gd films with thickness of about 200 Å were prepared by a method described previously.[1] Many basal grains contained a family of parallel dislocations which originated during deformation. These dislocations by their appearance seemed to be extending from the top surface to the bottom surface of the (0001) oriented thin film. Diffraction contrast experiments relevant to h.c.p. crystals[2] showed that the dislocations were of nearly screw-character with Burgers Vector, $\vec{b} = \vec{c} + \vec{a}$, and were lying on $(11\bar{2}2)$ pyramidal planes. These dislocations, when subjected to several successive temperature gradient anneals employing electron-beam pulse annealing in the microscope, decomposed into rows of dislocation loops. A typical transmission electron micrograph exhibiting $\vec{c} + \vec{a}$ dislocations and the corresponding rows of dislocation loops is shown in Figs. 1 and 2.

Screw dislocations are known to decompose to helical dislocations and then to loops by interaction[3,4] with vacancies through climb-process. It is thought that the generation of dislocation loops in the present case occurs as a result of the formation and interaction of helixes. The inclined $\vec{c} + \vec{a}$ dislocations are intersecting the (0001) foil at opposite ends and will thus be subjected to strong image-forces.[5] The image-forces will pin up the dislocation at opposite ends where these intersect the film surfaces, since the dislocations are lying on $(11\bar{2}2)$ planes and thus cannot become oriented perpendicular to (0001) foil plane. The film is subjected to temperature gradient anneal employing pulse annealing technique, there will thus be a vacancy current,[1] the dislocations will interact with these vacancies and produce helical dislocations in the usual way. Evidence for the presence of helical dislocations was obtained during intermediate stages of pulse anneal and this shows that helix formation precedes the loop formation. It has been conjectured that the temperature gradient-induced vacancy current will be very suitable for climb in opposite senses of the nearby nearly screw dislocations.[3] No experimental observations have been however reported regarding this. In the present case, since the vacancy current is temperature gradient-induced, the vacancies will migrate away from one place and towards a nearby place in the crystal foil. This flow will induce climb in opposite senses in the two nearby $\vec{c} + \vec{a}$ dislocations, leading to formation of two helixes of opposite senses. These helixes will then interact and produce row of dislocation loops.[3,4] It is evident that the equilibrium distances between rows of loops will not be the same as that between initial dislocations, this feature can be easily noticed in Figs. 1 and 2.



Figs. 1–2

For temperature gradient-induced vacancy flow the non-equilibrium concentration c of vacancies in terms of the local equilibrium concentration c_0 can be expressed by the expression[1,6]

$$ln \frac{c}{c_0} = \frac{Q^* - H}{RT} \left(\frac{T}{T_0} - 1 \right)$$

where Q^* is the coupling coefficient, H is the vacancy formation energy, R is the gas constant, T and T_0 are respectively the highest attained temperature and the temperature near the boundary of the circular region over which the temperature gradient is superimposed.

Substituting the values of the above parameters applicable to the present case,[1-6] $Q^* - H \simeq 1$ eV, T = 1100° C, T_0 = 300° C, we find that $c/c_0 \simeq 39$. This is much greater than the value of about 10^{-3} which is thought to be necessary for helix and loop formation in bulk specimens.[2-4] In the present case, since the specimen is in the thin film form, as is well known, a large portion of the vacancy population will go to surfaces. However, even if a small part of the vacancy population goes to interact with the dislocations, the formation of helixes and the consequent loops will take place.

Department of Physics, M. M. SRIVASTAVA.
Banaras Hindu Univ., O. N. SRIVASTAVA.
Varanasi-5, India. *May* 20, 1970.

---

1. Srivastava, O. N. and Silcox, J., *Phil. Mag.*, 1968, **18**, 503.
2. Price, P. B., *Ibid.*, 1960, **5**, 873.
3. Amelinckx, S. and Bontinck, W., *Ibid.*, 1957, **2**, 94.
4. Thomas, G. and Whelan, M. J., *Ibid.*, 1959, **8**, 511.
5. Weertman, J. and Weertman, J. R., "Elementary Dislocation Theory," Macmillan Series in *Materials Science*, 1967 168.
6. Kumar, J. and Srivastava, O. N., *Phil. Mag.*, 1969, **20**, 1281.

OXIDIMETRIC DETERMINATION OF PHLOROGLUCINOL

THOUGH cerium(IV) salts in sulphuric and perchloric acid media have been extensively employed in the oxidimetric determination of organic compounds, the oxidation of phloroglucinol has not yet been investigated. Since hydroquinone containing two hydroxy groups is oxidized instantaneously to quinone with ceric sulphate it was considered interesting to study the oxidation of phloroglucinol containing three hydroxy groups with the same reagent. Phloroglucinol occurs as a constituent of many resins and is a useful starting material in the synthesis of naturally occurring flavone and flavanol pigments.

Reagents: Ceric sulphate.—The requisite amount of ceric ammonium sulphate (B.D.H.) is made into a paste with concentrated sulphuric acid, warmed, dissolved in distilled water and made up to one litre. Final normality of sulphuric acid is one and that of cerium(IV) ≃ 0·100. This solution is standardised employing the usual methods. Phloroglucinol (Rideal de Haen) was dissolved in distilled water to give a 0·010 molar solution of the compound. N-phenyl anthranilic acid solution is prepared by dissolving 0·1 gm. of the acid along with 0·1 gm. of sodium carbonate in 100 ml. distilled water.

Ferrous ammonium sulphate.—B.D.H. AnalaR ferrous ammonium sulphate was employed in preparing 0·05 M Fe(II) solution in one molar sulphuric acid. The solution was standardised everyday with standard potassium dichromate solution. All other reagents used were of standard and tested purity.

To a measured aliquot of phloroglucinol solution taken in a 250 ml. Erlenmeyer flask a known excess of ceric sulphate solution is added. Sufficient amount of sulphuric acid is added to bring the acid normality to the desired level and the volume made up to 75 ml. The solution was heated on a water-bath, and after cooling the excess cerium(IV) remaining in the solution is titrated with Mohr's salt solution using N-phenyl anthranilic acid as indicator. The effect of the following variables was investigated:

(1) Effect of acidity; (2) Effect of time of heating; (3) Effect of excess cerium(IV). In all cases blanks were run and suitable blank corrections applied to the final titre value.

From a study of the different variables it was found that heating for 30 minutes on water-bath in presence of one molar sulphuric acid employing a minimum of 30-fold excess cerium(IV) gave the best possible results. The relults given in Table I employing different amounts of phloroglucinol under these conditions indicate that 24 equivalents of cerium(IV) are utilised in the oxidation of each mole of the compound. For the complete oxidation of phloroglucinol to carbon dioxide and water according to the equation

$$C_6H_6O_3 + 9\,H_2O \rightarrow 6\,CO_2 + 24\,H^+ + 24\,e^-,$$

each mole of phloroglucinol requires 24 moles of

TABLE I

Oxidation of phloroglucinol with ceric sulphate

Phloroglucinol millimoles taken	0·010	0·020	0·030	0·040
Cerium (IV) millimoles consumed	0·241	0·480	0·723	0·960
No. of moles of cerium (IV) consumed per mole of phloroglucinol	24·1	24·0	24·1	24·0

one electron oxidant such as cerium(IV). Hence it may be concluded that under the above conditions oxidation of phloroglucinol goes to completion giving carbon dioxide and water as final products. The evolution of carbon dioxide during the oxidation has been tested qualitatively. The oxidation seems to proceed *via* a free radical intermediate as in the case of oxidation of several other organic compounds with cerium(IV) in sulphuric acid solution.[2] Here also acrylo-nitrile test indicated the presence of free radical in the reaction mixture. The results also indicate that phloroglucinol can be estimated volumetrically under the prescribed conditions employing ceric sulphate.

Chemistry Department, G. Nageswara Rao.
Indian Institute of D. O. Shah.
Technology,
New Delhi-29, *May* 30, 1970.

---

1. Kolthoff. I. M. and Belcher, R., *Volumetric Analysis*, Vol. III, Interscience Pub., New York, 1957.
2. *Oxidation in Organic Chemistry*, Edited by Wiberg, K. W., Interscience Pub., New York, 1965.

THERMAL DECARBOXYLATION OF SUBSTITUTED CHLOROBENZOIC ACIDS

Thermal decarboxylation studies on salicylic[1] and chlorobenzoic[2] acids in solvents glycerol and resorcinol have shown that when *ortho*, *para* directing substituents are present in *ortho* or *para* position to the carboxylic group, the reaction proceeds by an S_E2 mechanism. The kinetic investigation of Sastry *et al.*[3] on 3-nitro and 3, 5-dinitro salicylic acid also indicated that the introduction of a nitro group in 3- and 3, 5-positions decreased the rates and energies of activation of salicylic acid in resorcinol though following the same S_E2 mechanism. The decrease in rate constants and other thermodynamic parameters were attributed to the deactivating influence of the nitro group.

In view of the above studies, thermal decarboxylation of nitro-substituted chlorobenzoic acids have been carried out in neutral solvent, glycerol and the results are presented in Table I. The apparatus used and method employed for following the rates were same as those given in our earlier paper.[4]

From our recent investigations, it was concluded that *m*- and *p*-nitrobenzoic acids follow an S_E1 mechanism, in which the cleavage of the C–C bond between carboxyl carbon and the carbon atom of the ring is the rate-determining step. The 3- and 4-nitrochlorobenzoic acids were found to be stable in resorcinol unlike nitro-salicylic acids and showed higher rates than the corresponding *o*- and *p*-unsubstituted chlorobenzoic acids and even more than *m*- and *p*-nitrobenzoic acids in glycerol. Hence, it is concluded that these acids, unlike simple chlorobenzoic acids, follow an S_E1 mechanism. This was further confirmed by studying the effect of boric acid on the rate constants which decreased with increase of boric acid concentration in glycerol. The change in mechanism from S_E2 to S_E1 for the chloro and nitro-substituted chlorobenzoic acids may be explained as follows.

From the dissociation constants of aromatic halogeno acids, it was concluded that the inductive effect of the halogens becomes the predominant factor and deactivates the ring, although it is superimposed by the mesomeric effect in many electrophilic substitution reactions.[5] Further it was observed that the acid strength is enhanced by introducing a *meta* orienting substituent in 3-position. Thus, the inductive effect of the chlorine group and the inductive and mesomeric effects of the nitro group together deactivates the ring and thus facilitates—C–C bond cleavage resulting in high rates of decarboxylation.

Table I

Kinetic data on the thermal decarboxylation of nitro-chlorobenzoic acids in glycerol in the temperature range 200–250° C.

Acid	$K \times 10^4$	$k \times 10^4$ sec.$^{-1}$	ΔE^* k.cals.	ΔH^* k.cals.	ΔF^* k.cals.	ΔS^* e.u.
o-Chloro[2] ..	11·97	2·7	39·6	38·6	37·1	− 0·56
p-Chloro[2] ..	1·04	3·5	40·6	39·6	37·9	− 3·39
m-Nitro[4] ..	3·35	20·0	17·7	16·7	37·4	−39·00
p-Nitro[4] ..	3·70	22·5	17·5	16·5	37·2	−39·10
4-Chloro-3-nitro	4·60	28·1	28·3	27·3	36·7	−17·10
2-Chloro-3-nitro	87·00	53·4	19·3	18·3	36·4	−33·80
2-Chloro-4-nitro	103·00	52·4	20·1	19·1	33·3	−32·24

From a study of dipole moments and interatomic distances Jenkins[6] has concluded that as the distance between the substituent and the carboxyl group decreases, the influence of the inductive effect overweighs the mesomeric effect in isomeric halogeno acids. The high rates of decarboxylation of 2-chloro and 2-chloro-4-nitro, 3-nitrobenzoic acids as compared to 4-chloro, 3-nitrobenzoic acid observed in the present investigation supports Jenkin's view. From the knowledge of ionisation constants of 2-chloro-3-nitro and 2-chloro-4-nitrobenzoic acids it is likely that the former should have a low rate compared to its *ortho* isomer. However, from the experimental observation it is found that 2-chloro-3-nitrobenzoic acid decarboxylates at a higher rate than 2-chloro-4-nitrobenzoic acid. This is due to the fact that the halogen atom in the 2-chloro-3-nitrobenzoic acid is bent out of the plane of the ring by the large groups on either side of it and thus is prevented from attaining the planar configuration necessary for the mesomeric effect. Since the nitro group is *para* to carboxyl group, in 2-chloro-4-nitrobenzoic acid, such a steric effect is improbable and results in a low rate. A comparison of the enthalpies and entropies of activation of the two isomers is a further evidence for the proposed S_E1 mechanism. Although the inductive effect of the chlorine is the predominant factor, it is superimposed by the mesomeric effect to a greater extent in 4-chloro-3-nitrobenzoic acid. The net effect arising from the combination of these two increases the C–C bond strength and results in higher enthalpy of activation than its *ortho* isomer. This seems to be the reason for the low rate observed in the 4-chloro-3-nitrobenzoic acid.

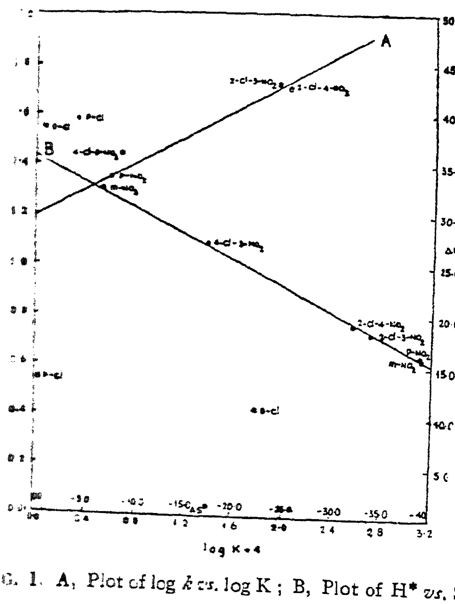


FIG. 1. A, Plot of log *k* *vs.* log K; B, Plot of H* *vs.* S*.

The plot of log *k* against log K gave a linear relationship as in Fig. 1, A with a slope of − 0·27 suggesting that the decarboxylation is facilitated by electron withdrawing groups, a characteristic of the S_E1 mechanism.[8] The other plot, Fig. 1, B, ΔH^* against ΔS^* also reveals that all these acids follow a similar mechanism except o- and p-chlorobenzoic acids and the isokinetic temperature is calculated as 509° K.

Thanks are due to Prof. N. V. Subba Rao for his keen interest and to the Government of India for granting a Research Training Scholarship to one of us (D. S.).

Dept. of Chemistry, Osmania University, Hyderabad-7, *June* 12, 1970.
Mrs. D. Sita Manikyam.
E. V. Sundaram.

---

1. Brown, B. R., Hammick, D. H. LL. and Scholefield, A. J. B., *J. Chem. Soc.*, 1950, p. 778.
2. Muhammad, S. S. and Aziz Siddiqui, *Thesis*, approved by Osmania University, 1957.
3. Sastry, K. S., Sundaram, E. V. and Muhammad, S. S., *Curr. Sci.*, 1968, **37**, 643.
4. Sita Manikyam, D. and Sundaram, E. V., *Bull. Chem. Soc., Japan* (In press).
5. Dippy, J. F. J., *Chem. Revs.*, 1939, **25**, 150.
6. Jenkins, H. O., *J. Chem. Soc.*, 1939, p. 640.
7. Hammett, L. P., *Physical Organic Chemistry*, McGraw-Hill Co., New York, 1940, p. 184.
8. Brown, B. R., *Quart. Revs.*, 1951, **5**, 131.
9. Clark, L. W., *J. Phys. Chem.*, 1956, **60**, 1340; 1958, **62**, 70.

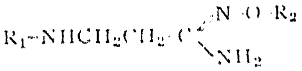
2-SUBSTITUTED AMINOPROPIONAMIDOXIMES AND THEIR DERIVATIVES

Aminoacetamidoximes, having alkyl or aryl substituents on the nitrogen, have been reported[1] to possess fungicidal properties. 2-Arylaminopropionic acids and their amides have been claimed[2] to possess antidiabetic activity. So, the synthesis of 2-substituted aminopropionamidoximes and their carbamate derivatives was undertaken.

The 2-substituted aminopropionitriles required for our work were prepared by standard literature methods.[3] The nitriles were converted to the corresponding amidoximes in 40–60% yields by reacting them with hydroxylamine in aqueous ethanol. The oximes, on reaction with potassium cyanate, gave their O-aminocarbonyl derivatives. Compounds 4, 7 and 11 (Table I) have shown significant oral hypoglycemic properties, but they have also been toxic.

2-o-Chloroanilinopropionamidoxime.—2-o-Chloroanilinopropionitrile (4·5 g.; 0·025 mole), hydroxylamine hydrochloride (1·75 g.; 0·025 mole) and potassium carbonate (1·75 g.; 0·013 mole) were refluxed in 80% ethanol (100 ml.) for 5 hours. The solvent was removed *in vacuo*; the gummy residue was washed with ice-cold water and then chromatographed over a 20″ × 1·5″ column of acid-washed alumina slurry-packed in benzene. The column was progressively eluted with benzene (400 ml.), benzene-ethanol (75%-25%; 300 ml.), benzene-ethanol (50%-50%; 300 ml. and ethanol (600 ml.) and 100 ml. fractions were collected. Fractions 2-4 gave 2-*o*-chloroanilinopropionitrile (2·3 g.) and fractions 11-14 gave 2·4 g. of the title product. It was crystallised from ethanol-benzene-hexane; m.p. 69-70°.

TABLE I



$$R_1-NHCH_2CH_2\cdot C\begin{smallmatrix}\nearrow N\cdot O\cdot R_2\\ \searrow NH_2\end{smallmatrix}$$

No.	R_1	R_2	m.p. C.*	Nitrogen %	
				Found	Calc.
1	Phenyl ..	H : 2 HCl†	180-82	16·45	16·67
2	Benzyl ..	H : 2 HCl†	181-83	15·95	15·80
3	Phenylethyl ..	H : 2 HCl	180-82	15·32	15·00
4	Cyclohexyl ..	H	114-15	22·79	22·71
5	*o*-Chlorophenyl	H	69-70	19·37	19·67
6	,, ..	H : 2 HCl	195-96	14·31	14·67
7	,, ..	CONH₂	59-60	21·62	21·83
8	*m*-Chlorophenyl	H	79-80	19·81	19·67
9	,, ..	H : 2 HCl	189-90	14·79	14·67
10	,, ..	CONH₂	84-85	21·63	21·83
11	*p*-Chlorophenyl	H : 2 HCl	170-72	14·74	14·67
12	,, ..	CONH₂	112-13	21·58	21·83
13	*o*-Tolyl ..	H : 2 HCl	188-90	15·61	15·80
14	,, ..	CONH₂	89-90	23·49	23·73
15	*m*-Tolyl ..	H : 2 HCl	193-94	15·45	15·86
16	*p*-Tolyl ..	H	82-83	21·61	23·76
17	,, ..	H : 2 HCl	187-88	15·59	15·80
18	,, ..	CONH₂	68-70	23·54	23·73
19	*o*-Anisyl ..	H	91-92	20·34	20·09
20	,, ..	CONH₂	59-60	22·41	22·22
21	*m*-Anisyl ..	H : 2 HCl	182-84	14·63	14·89
22	,, ..	CONH₂	109-10	23·23	22·22
23	*p*-Anisyl ..	H	92-93	20·06	20·09
24	,, ..	CONH₂	123-24	22·53	22·22

* All melting points are uncorrected. † Halogen estimation corresponded to 2 HCl.

O-Aminocarbonyl-2-o-chloroanilinopropionamidoxime.—To a cold solution of 2-*o*-chloroanilinopropionamidoxime (1·8 g.; 0·01 mole) in dilute hydrochloric acid (10 ml.; 2 N) was added a solution of potassium cyanate (0·9 g.; 0·011 mole). After 10 minutes at 5°, the reaction solution was rendered neutral with ammonia. The resulting gummy mass gradually solidified; it was crystallised from acetone-benzene-hexane; m.p. 59-60°.

The rest of the compounds in Table I were similarly prepared.

Sarabhai Res. Centre,
Wadi Wadi,
Baroda-7, *June* 15, 1970.

S. SOMASEKHARA.
D. M. DESAI.
S. L. MUKHERJEE.

---

1. De Benneville, P. L. and Hollander, C. S. (to Rohm and Hass Co.), *U.S.*, 2,947, 782; *C.A.*, 1961, **55**, 3624.
2. Fr. Pat., 5881, M., *Fine Chem. Pat. J.*, 1968, **8** (21), 4.
3. Rabjohn, N., *Organic Synthesis*, John Wiley & Sons, 1963, Coll. Vol. 4, 205.

EFFECT OF PARAOXON ON THE SOMATOSENSORY EVOKED POTENTIALS IN THE RAT

THE transmitter function of acetylcholine in the cerebral cortex has been the subject of many investigations. Application to the cortex of drugs that influence cholinergic synapses gave results that were often contradictory and difficult to interpret.[3] Another approach to the cortical cholinergic mechanisms has been made by studying the effect of topically applied cholinomimetic drugs on the somatosensory evoked potentials. Bhargava[1] has shown that the cortical application of artificial cerebrospinal fluid (CSF) containing various concentrations of acetylcholine increases the amplitude of the repetitive after-discharges of the somatosensory cortex, whereas they do not influence the short latency positive-negative primary complex of the cortical evoked potentials. It appears that the short latency primary evoked potential is not cholinergic, as Mitchell[4] has shown that under chloralose anaesthesia acetylcholine output is greatly reduced while the initial positive-negative potential is increased. It seems that the activity of cholinoceptive units rather manifests itself in potentials of longer latency (*i.e.*, repetitive after-discharges).

The present experiments were undertaken to study the effect of cortical application of paraoxon (an irreversible inhibitor of cholinesterase) on the somatosensory evoked potentials, and to find out the cholinergic component of the cortical evoked potentials. The study may throw more light on the intra-cortical cholinergic mechanisms.

In rats (CFE strain from Carworth, Europe) lightly anaesthetised with pentobarbitone, the technique of Bhargava and Meldrum[2] was employed to record the averaged somatosensory evoked potentials. Computer derived averages of 32 consecutive somatosensory evoked potentials from both cortices, in response to the stimulation of contralateral and ipsilateral forepaws, were recorded. Paraoxon dissolved in CSF was applied to the pial surface through especially designed cortical cups. In most experiments the drug was applied to only one cortex while the other cortex was bathed with normal CSF and served as control throughout the experimental period.

A continuous record of spontaneous electrocortical (EEG) activity and cortical and rectal temperatures was obtained on the different channels of the polygraph (Devices).

Paraoxon was applied in different concentrations (10^{-5} M ; 3×10^{-5} M ; 10^{-4} M and 10^{-3} M) to the cortex for a period of 30 minutes, and its effect on the somatosensory evoked potentials was observed. With each concentration at least 4 to 6 experiments were performed.

In most of the experiments paraoxon produced an increase in the amplitude of the repetitive after-discharges of the cortical evoked potentials. The short latency positive-negative complex was not affected after cortical application of paraoxon. This effect was more marked with less concentrations of paraoxon (up to 10^{-4} M); higher concentration had little effect and even caused the death of some of the animals. The best effect was however obtained with 3×10^{-5} M of paraoxon. The effect on the repetitive after-discharges usually started within 15–20 minutes of the application of the drug, and lasted for more than 6–8 hours after washing off the drug.

In the control cortex the evoked potentials following contralateral or ipsilateral stimulation were unchanged.

The present study shows that paraoxon only produces its effect on the long latency (repetitive after-dicharge) component of the cortical evoked potentials, whereas the primary complex remains unaffected. This effect of paraoxon is due to preservation of acetylcholine because of inhibition of the enzyme acetylcholinesterase. The result thus provides an electrophysiological evidence that the afferent pathways responsible for the repetitive after-discharges are cholinergic in nature while those for the primary complex probably do not involve cholinoceptive synapses. A more detailed study has to be done for further confirmation of this intra-cortical cholinergic mechanism.

Medical Res. Council,
Neuro-psychiatry Unit,
Carshalton (U.K.), *June* 4, 1970.

V. K. BHARGAVA.*

---

* Present address: Department of Pharmacology, Maulana Azad Medical College, New Delhi.

1. Bhargava, V. K., *Ph.D. Thesis*, Council for National Academic Awards, London, 1969.
2. — and Meldrum, B. S., *Brit. J. Pharmacol.*, 1969, p. 112.
3. Chatfield, P. O. and Purpura, D. P., *Electroenceph. clin. Neurophysiol.*, 1954, **6**, 287.
4. Mitchell, J. F., *J. Physiol.*, 1963, **165**, 98.

BIOSYNTHESIS OF PLANT STEROLS THE MECHANISM OF THE ALKYLATION OF α-SPINASTEROL AT C-24

IN the mechanism postulated for the alkylation of phytosterols, the hydrogen atom at C-24 migrates to C-25.[1,2] We reported earlier[3] that the incorporation of (3RS)-[2-^{14}C(4R)-4-^{3}H$_1$]-mevalonic acid into *Camellia sinensis* yielded α-spinasterol which had ^{3}H/^{14}C atomic ratio of 2·44 : 5 instead of 3 : 5. It was pointed out that the process of alkylation in this phytosterol may proceed simultaneously by two routes; one route involving the intermediate in which ^{3}H at C-24 is lost, possibly during the formation of 24-methylene intermediate and the other route in which ^{3}H is transferred to C-24 through the carbonium ion mechanism. In the present communication we report experimental evidence supporting the above possibility.

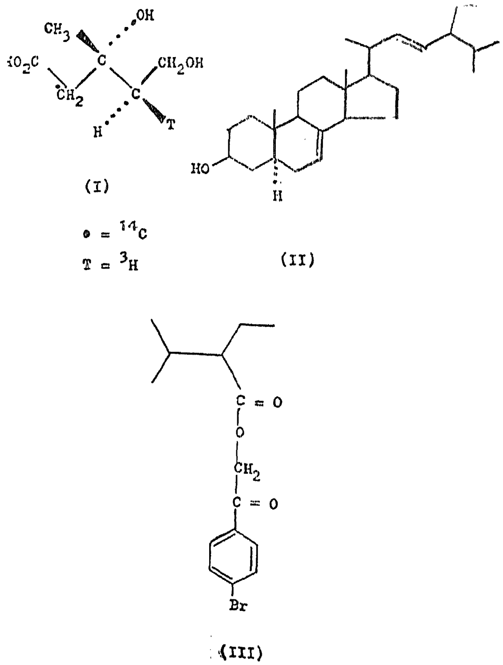


FIG. 1

(3RS)-[2-^{14}C-(4R)-4-^{3}H$_1$]-mevalonic acid (I) (^{3}H/^{14}C ratio 5·37; 50 μc of ^{14}C) was administered to the *Camellia sinensis* plant as previously described.[3] The plant was harvested after five weeks and α-spinasterol (II) was isolated from the non-saponifiable lipid in the usual manner.[3] The carrier α-spinasterol was added and the sterol crystallized to constant specific activity and $^{3}H/^{14}C$ ratio 2·67, atomic ratio (a.r.) 2·44 : 5. Oxidation[1] of the biosynthetic α-spinasterol yielded 2-ethyl-3-methylbutanoic acid which was isolated as the *p*-bromophenacylester derivative (III) and purified by *tlc* on silica gel. The $^{3}H/^{14}C$ ratio obtained was 2·74 (a.r. 0·51 : 1).

These results indicate that only 50% of the expected tritium migrates to the C-25 position and the other 50% is eliminated, probably during the formation of the intermediate C-24-methylene derivative.

The author wishes to thank Dr. K. R. Varma, Department of Chemistry, Harvard University, Cambridge, Massachusetts, for sending the sample of authentic *p*-bromophenacylester derivative of 2-ethyl-3-methylbutanoic acid. He also wishes to thank Professor W. R. Nes, Drexel University, Philadelphia, Pennsylvania, for his stimulating discussion during this study.

Department of Biochemistry,
University of Tennessee,
Memphis, Tennessee 38103, *June* 9, 1970.
RAMESHWAR K. SHARMA.

---

1. Akhtar, M., Hunt, P. F. and Parvez, M. A., *Biochem. J.*, 1967, **103**, 616.
2. Raab, K. H., DeSouza, N. J. and Nes, W. R., *Biochim. Biophys. Acta*, 1968, **152**, 742.
3. Sharma, R. K., *Phytochemistry*, 1970, **9**, 565.
4. Conner, R. L., Mallory, F. B., Landrey, J. R. and Iyengar, C. W. L., *J. Biol. Chem.*, 1969, **244**, 2325.

ANTIESTROGENICITY OF NORGESTREL

NORGESTREL (*dl*-17 α-ethinyl-13 β-ethyl 17 β-hydroxygon-4-en-3 one), a synthetic progestogen has been reported to be a highly potent estrogen antagonist at the same time being completely free from estrogenicity.[1] Continuous daily oral administration of this steroid in micro doses prevents pregnancy in women and rats.[2,3] The antiestrogenic property has been considered to be a crucial factor in contraceptive *modus operandi* of the progestogen.[3]

The present communication is concerned with the assessment of antiestrogenic potency of norgestrel in terms of its effect on vascular permeability of the rat uterus.

Colony-bread albino rats (150–200 gm.) of the Institute with regular estrus cycle (4–5 days) were used. Norgestrel (0·3 μg./rat, oral), estrone (1 μg./rat, i.m.) and progesterone (0·25, 0·50, 1·00 and 2·00 mg./rat, i.m.) were given in olive oil. The vascular permeability of the uterus was determined by the method of Cecil *et al.*[4] with the modification that intact diestrus animals were used instead of ovariectomized ones.

After a single dose of norgestrel the vascular permeability of the uterus registered a marked fall between 3 and 9 hr. (*vs.* control $P < 0 \cdot 01$, Table I), but returned to normal at 12 hr.

TABLE I

Effect of norgestrel on vascular permeability of the rat uterus

Control	Hours after norgestrel administration			
	3	6	9	12
6·41 ±0·65 (9)*	1·00 ±0·26 (6)	3·02 ±0·41 (9)	2·13 ±0·20 (9)	7·60 ±1·06 (9)

* Mean ± S.E. with number of animals in parentheses; vascular permeability expressed as μg. trypan blue/100 mg. uterine tissue.

Assessment of graded doses of progesterone (3 hr. after injection) showed that the inhibition of uterine permeability caused by 0·5 mg. dose was equivalent to the effect seen after administration of 0·3 μg. norgestrel (Table II).

TABLE II

Effect of graded doses of progesterone on vascular permeability of the rat uterus

Treatment		μg. trypan blue/100 mg. uterine tissue
Control	..	6·41 ± 0·65 (9)*
Progesterone—		
0·25 mg.	..	3·25 ± 0·23 (4)
0·50 mg.	..	2·11 ± 0·22 (5)
1·00 mg.	..	1·35 ± 0·39 (5)
2·00 mg.	..	0·51 ± 0·03 (4)

* Mean ± S.E. with number of animals in parentheses.

In other words, the antipermeability effect of the latter was about 1666 times as high as that of progesterone. Further, it was evident that 2 mg. progesterone reduced the permeability to about 1/15th of the normal value within 3 hr. When assayed by the mouse vaginal cornification method norgestrel was found to be about 730 times more active than progesterone.[1]

Administration of norgestrel to rats either concurrently or 3 hr. after estrone (*i.e.*, 3 hr. prior to sacrifice) not only prevented the characteristic estrogen-induced rise in vascular permeability[4] (*vs.* control, $P < 0{\cdot}01$), but also reduced it drastically (*vs.* control or estrone, $P < 0{\cdot}01$, Table III). However, norgestrel given 3 hr. before sacrifice to estrogenised animals seemed to exert a more profound antipermeability effect than when administered concurrently with estrone ($P < 0{\cdot}01$). Thus a dose of 0·3 μg. norgestrel was sufficient to nullify the stimulatory effect of 1 μg. estrone, and at the same time to exert its intrinsic inhibitory influence on the uterine vascular permeability.

TABLE III

Effect of norgestrel on uterine vascular permeability of rats pretreated with estrone

Treatment		μg. trypan blue/100 mg. uterine tissue
Control ..		6·41±0·65 (*9*)
Estrone ..	(6 hr.)	9·00±0·87 (*8*)*
Estrone + Norgestrel	(6 hr.) (3 hr.)	1·96±0·21 (*5*)
Estrone + Norgestrel	(6 hr.) (6 hr.)	3·22±0·17 (*6*)

* Mean ± S.E. with number of animals in parentheses.

It thus appears that the potent antipermeability effect of norgestrel is crucially involved in its contraceptive *modus operandi*, conceivably by depriving the uterus of some of the essential substrates and co-factors which may be needed for growth, differentiation and nidation of the blastocyst, as well as for the sustenance of pregnancy.

This investigation was supported by grants from the Ministry of Health, Family Planning and Urban Development, Government of India, and the Ford Foundation. The authors are grateful to Dr. M. L. Dhar for his interest in this study.

Central Drug Res. Inst.,
Lucknow
(Communication No. 1528),
June 8, 1970.

P. R. DASGUPTA.
MAYA GHOSH.
J. K. PANDE.
AMIYA B. KAR.

---

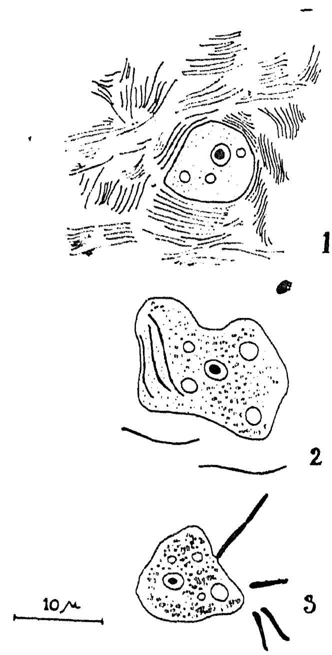
1. Edgren, R. A., Jones, R. C., Clancy, D. P. and Nagra, C. L., *J. Reprod. Fertl.*, 1968, Suppl. 5, p. 13.
2. Foss, G. L., Svendsen, E. K., Fotherby, N. and Richards, D. J.. *Brit. Med. J.*, 1968, **2**, 489.
3. Sen, A. (Late), Sanwal, P. C., Srivastava, A. K., Pande, J. K., Dasgupta, P. R. and Kar, A. B., *Contraception*, 1970 (submitted for publication).
4. Cecil, H. E., Hannum, J. A., Jr. and Bitman, J., *Am. J. Physiol.*, **1966**, **211**, **1099**.

FORMATION OF SUPERNUMERARY SURFACE LAYERS IN RADIATED AMOEBAE

A SPECTACULAR peeling off of the surface layer has been observed from the radiated soil amœba—*Acanthamœba* sp. This process of denuding of the surface layer has been observed in a variety of dosages employed. The most significant effect, however, has been seen in the irradiated amœbæ, in the 3rd subculture of 125,000, 150,000 and 175,000 rads and in the 2nd subculture of 200,000 rads. For irradiation upto 1,500 rads, a Picker's Army Field X-ray unit was used at 70 KVP; 4 mA; 555 rads/min. with 0·25 mm. Al-filter. A water-cooled Muller's MG-150 X-ray machine was used for the doses 2,000 rads and above, operated at 80 KVP; 9 mA; 4,000 rads/min. (for further details *see* Chatterjee[1]).

The denudated surface layers were arranged concentrically around the amœbæ (Fig. 1). After peeling off of the surface layers amœbæ never remained naked because continuously new surfaces were formed within the cell body to replace the previously shredded off limiting membrane. Layer after layer of new surface materials were being continuously formed and periodically thrown out. They appeared as concentric layers surrounding the amœbæ, filling up quite a portion encircling the cell body. Such amœbæ were immobilised and firmly attached to the glass surface. In the following few subcultures the incidence of peeling off of the surface layers became infrequent and finally disappeared in the onward subcultures.

At lower dosages, *viz.*, between 50–15,000 rads, no detachment of the surface materials as distinct layers was visible. From the 3rd subculture, localised areas were found where supernumerary depositions of membrane were noticed inside the cell (Fig. 2). These areas of isolated patches of extra surface membrane might be present in some particular region of the cell. These could be thrown out and discarded. This phenomenon of production of extra surface material was continued for 6th and 7th subcultures. The size of the peeled off surface became gradually smaller before their final disappearance in the further culture. Often the ejected surface areas appeared as stiff rod-like bodies projecting out from the cell having a dense mass (Fig. 3). Their length varied from 3–15 mμ. or even more. Sometimes, the lifted surface material from the cytoplasm were fragmented into a number of still smaller portions before their final elimination from the cell.



FIGS. 1–3

The peeling off of the surface layer suggested overproduction of surface-forming material induced as an after-effect of irradiation. In normal amœbæ such a phenomenon has never been seen. Overproduction of cell surface in radiated amœbæ can be taken as an induced phenomenon of a concerned activity of synthesis. It is still interesting to note that such overproduction can take place only during the active phase of trophic life of the amœba and not during the inactive phase of the cystic life (Mookerjee and Hajra[2]). It must be pointed out in this connection that whenever the trophic forms were mobilising in the excessive production of their surface layers, they invariably failed to undergo regular binary fissions and resulting into scanty culture.

Claims have already been made that a process of active synthesis goes on near the surface layer which results in the constant replacement of the previous limiting membrane. Bell[3] and Wolpert *et al.*[4] have suggested that the membrane may be synthesized *in situ* by enzymatic sites forming part of the membrane itself, particularly as the internal membranes of the cell have many synthetic functions. Radiation seems to stimulate this synthetic activity in the treated amœba. The theory is that the amœba renews its surface each time when it passes through its own length (Goldacre[5,6]). This view speaks of an ephemeral nature of the surface layer which is continually being formed to be replaced. Weiss[7] and Rosenberg[8] have advanced the idea that the cell surface is constituted by the staggering of many monolayers of protein films which are constantly shed as the cell mobilizes itself in movement. In the present set-up, the radiated amœbæ were attached on the glass surface and became imprisoned in a state of immobilisation and the active formation of layers are staggered around the cell body as distinct elements.

Another impressive case of the present result is to show that the surface is a definite structure distinguishable from the rest of the cytoplasm. This lends support to the other experiments where lifting and separation of surface layer were done by immersing the amœbæ in Alcian blue Nachmias[9] at 5° C., though it is not yet clear whether in this case only the polysaccharide part or the protein part is also lifted. Preliminary cytochemical tests which were carried out showed that the protruded cell surfaces gave RNP and alkaline phosphatase positive reaction but failed to do so when they were detached from the cell body of amœbæ.

Dept. of Zoology, SIVATOSH MOOKERJEE.
Presidency College, SAMAR CHATTERJEE.
Calcutta-12, *June* 19, 1970.

---

1. Chatterjee, S., *Zeit fur Biol.*, 1968, **116**. 68.
2. Mookerjee, S. and Hajra, B., *Proc. Nat. Inst. Sci. India*, 1960, **26**, 51.
3. Bell, L. G. E., *J. Theoret. Biol.* 1961, **1**, 104.
4. Wolpert, L., Thompson, C. M. and O'Neill, C. H., In *Primitive Motile System in Cell Biology* (Eds. R. D. Allen and N. Kamiya), Academic Press, New York, 1964, p. 143.
5. Goldacre, R. J., *Intern. Rev. Cytol.*, 1952, **1**, 135.
6. —, *Exptl. Cell Res. Suppl.*, 1961, **8**, **1**.
7. Wiess, P , *Rev. Modern Phys.*, 1959, **31**, 419.
8. Rosenberg, M , *Biophys. J.*, 1960, **1**, 137.
9. Nachmias, V. T., *J. Cell Biol.*, 1965, **27**, 71 A.

USE OF CONGLUTINATING COMPLEMENT ABSORPTION TEST FOR RAPID IDENTIFICATION OF ARBOVIRUSES

THE conglutinating complement absorption (CCA) test has been used in the sero-diagnosis of arboviruses. The test was found to be more sensitive than the ordinary hæmolytic complement fixation (CF) test in detecting the presence of arbovirus antibodies in serum.[1,2]

This communication deals with the adaptation of CCA test for rapid identification of arboviruses and reports the relative value of this procedure as compared to CF test.

A 10% (W/V) suspension of the infected infant or adult mouse brain in normal saline (0·9% NaCl) was made and centrifuged at 5,000 RPM for one hour at 4° C. The supernatant fluid was used as antigen. This antigen had shown a slight anti-complementary activity. Therefore, it was further diluted to 1 : 2 (sometimes 1 : 4) before use and was tested against two-fold dilutions (usually 1 : 16 to 1 : 1024) of homologous hyperimmune serum. The hyperimmune sera against arboviruses [Kyasanur Forest Disease (KFD), P 9605 strain; Kaisodi (KSO), G 14132 strain; Japanese encephalitis (JBE), Nakayama strain; West Nile (WN), E 101 or G 22886 strain; and dengue 2, P 23085 strain] were produced in adult mice.

Micro-CCA tests were done in hæmagglutination plastic plates according to the method described earlier.[3] CF testing was done by a micro-technique as described by Pavri *et al.*[4]

Seven hundred and fifty-two mouse brains were tested for evidence of arbovirus infection. Of these, 661 were positive in CCA for arbovirus and 655 in CF (Table I). Titres of hyperimmune sera with brain antigens, though not determined for end-points in all cases, were usually found to be two to four times higher in CCA than the CF.

TABLE I

Showing comparative results of CCA and CF tests with mouse brain antigens

Brain antigens	Total No. tested	No. positive with		Remark
		CCA	CF	
KFD ..	634	620	620	
KSO ..	10	0	0	
KSO/KFD	29	18	18	Positive for KSO
JBE/WN	8*	4	4	,, ,, JBE
		4	4	,, ,, WN
WN ..	24	4	4	
Dengue type 2	47	11	5	
Total No.	752	661	655	

* Antigens were tested with absorbed hyperimmune sera.

The CCA results indicated that KFD and KSO viruses could be distinguished from one another as well as from JBE-WN subgroup dengue virus. It was also possible to distinguish between the viruses of JBE-WN subgroup using JBE (Nakayama) and WN (E 101) hyperimmune sera absorbed as described by Clarke.[5] These results were similar to those observed with CF test by Pavri and Sheikh.[6]

These preliminary results suggest that CCA test may be used for rapid identification of arbovirus isolates. It was about as effective as the CF test.

I am grateful to Dr. T. Ramachandra Rao for his interest and encouragement in this study and to Dr. S. N. Ghosh for performing the complement fixation tests.

Virus Research Centre, GURKIRPAL SINGH.
Poona, *May* 20, 1970.

---

1. Singh, Gurkirpal, *Curr. Sci.*, 1969, **38**, 366.
2. —, *Ind. J. Med. Res.*, 1970 (In press).
3. —, *Ibid.*, Submitted for publication.
4. Pavri, K. M., Gokhale, T. and Shah, K. V., *Ibid.*, 1962, **50**, 153.
5. Clarke, D. H., *J. exp. Med.*, 1960, **111**, 21.
6. Pavri, K. M. and Sheikh, B. H., *Curr. Sci.*, 1966, **35**, 455.

A NOTE ON THE PREVALENCE OF *MELOIDOGYNE INCOGNITA* (KOFOID & WHITE, 1919) CHITWOOD 1949, IN VARIOUS PLANTS OF RAJASTHAN

A SURVEY in the cultivated fields, orchards and gardens in different parts of Rajasthan for root-knot nematode infestations was started in 1966. Root samples of affected plants were collected and preserved in 5% formalin for detailed examination.

Many workers have reported host plants of *M. incognita* from different parts of the country.[2-4] From Rajasthan there are only few reports of *Meloidogyne* species.[3,6] This is the first extensive report of various new and known host plants found infested with *M. incognita* and extends its range of geographical distribution in Rajasthan. Infested plants were brought to the laboratory. Roots were gently washed to remove the adhering soil. Females were dissected out and pareneal sections were cut and mounted on slides. At least 10 to 15 sections from each host were examined for the morphology of the pareneal pattern. Identification of the species was made on the basis of key given by Taylor *et al.*[5]

Various host plants, locality and degree of infestation are given in Table I. It may be observed from Table I that *M. incognita* has been observed attacking about 30 genera of 20 different families in Rajasthan. The families; Cucurbitaceæ, Solanaceæ, Umbelli-

TABLE I

Host List of Meloidogyne incognita

S. No.	Host	Family	Locality	Infection rating
1	*Althaea rosea* (L.) Gav. Holly hock ..	Malvaceæ	Udaipur	++
2	*Antirrhinium majus* L. (Snap dragon) ..	Scrophulariaceæ	do.	+++
3	*Apium graveolens* L. (Celery) ..	Umbelliferæ	do.	++++
4	*Brassica oleracea* var. *botrytis* L. (Cauliflowor)	Cruciferæ	do.	++
5	*Brasscia oleracea* var. *Capitata* L. (Cabbage) ..	do.	do.	++
6	*Brassica oleracea* var. *Caulorapa* L. (Knol Khol)	do.	do.	++
7	*Carica papaya* L. (Papaw) ..	Caricaceæ	Gogunda	+++
8	*Capsicum frutescens* L. (Capsicum) ..	Solanaceæ	do.	+
9	*Cococasia antiquorum* Schoff. (Calocasia) ..	Aracaceæ	Udaipur	++
10	*Centaurea cyanus* L. (Cornflower) ..	Compositæ	do.	++
11	*Cucumis sativus* L. (Cucumber) ..	Cucurbitaceæ	Gogunda	++++
12	*Cynodon dactylon* L. Pers. (Bermuda grass) ..	Gramineæ	Udaipur	++
13	*Cyperus rotundus* L. (Nutgrass) ..	Cyperaceæ	do.	+
14	*Ficus carica* L. (Cultivated Fig.) ..	Moraceæ	Kota	++
15	*Helianthus annus* L. (Sunflower) ..	Compositæ	do.	+++
16	*Hibiscus esculentum* L. (Okra) ..	Malvaceæ	Gogunda	
17	*Imp tiens balsamina* L. (Balsam) ..	Balsaminaceæ	Udaipur	++++
18	*Kochia* spp. ..	Chenepodiaceæ	do.	++
19	*Lagenaria sceeraria* (Bottle gouard) ..	Cucurbitaceæ	do.	++++
20	*Lycopersicon esculentum* Mill. (Tomato) ..	Solanaceæ	Gogunda	++++
21	*Momordica charantia* L. (Bitter gouard) ..	Cucurbitaceæ	do.	++++
22	*Musa paradisica* L. (Cultivated Banana) ..	Musaceæ	Jaipur Udaipur	++
23	*Portulaca oleracea* L. (Pigweed) ..	Portulacaceæ	Udaipur	+++
24	*Psiaium guajawa* L. (guava) ..	Myrtaceæ		+
25	*Punica granatum* L. (Pome granate) ..	Punicaceæ	Udaipur Khumbhalgarh	++ +
26	*Sesamum orientale* L. (Til.) ..	Pedaliaceæ	Alwar Udaipur	++ +
27	*Solanum melongena* L. (Egg fruit) ..	Solanaceæ	Shisod Udaipur	++++ ++++
28	*Vitis vinifera* L. (Grape) ..	Vitaceæ	Udaipur	+++
29	*Zea mays* L. (Maize) ..	Gramineæ	do.	++
30	*Zinnia elegans* L. (Zinnia) ..	Compositæ	do.	+

Arbitrary infection ratings: + Light. ++ Medium. +++ Heavy. ++++ Very heavy.

feræ and Balsaminaceæ have been found highly susceptible to *M. incognita*. Caricaceæ, Scrophulariaceæ, Compositæ, Malvaceæ, Portulacæceæ and Vitaceæ have been noticed susceptible. While the remaining 10 families given in Table I have been noticed less susceptible.

From the literature it appears that *Centaurea cyanus, Cynodon dactylon, Cyperus rotundus, Helianthus annus. Kochia* sp., *Punica granatum, Sesamum orientale* and *Psidium guajava* are the first host record of *M. incognita*. While in addition to these hosts *Althœa rosea*:

Antirrhynum majus; *Apium graveolens, Brassica oleracea* var. *Cauloropa*; *Ficus carica*; are the first host record of *M. incognita* from India. The localities of collection and host list indicate that this species is widely distributed in different soil conditions of Rajasthan and has wide host range.

The authors are thankful to Dr. B. K. Srivastava, Director, Agricultural Experiment Station, University of Udaipur, Udaipur, for providing the necessary facilities.

Agricultural Experiment
Station,
University of Udaipur,
Udaipur (Rajasthan),
May 26, 1970

B. S. YADAV.
M. K. VARMA.
S. M. NAIK.

---

1. Arya, H. C., *Sci. & Cult.*, 1957, **22**, 392.
2. Goody, J. B., Franclin, M. T., *Commonwealth Agri. Bureaux. Farnharm Royal*, Bucks, England, 1965.
3. Mathur, B. N., Handa, B. K. and Singh, H. G., *The Madras Agri. Jour.*, 1969, **56** (11), 744.
4. Swarup, G. and Koshi, P. K., *FAO. Tech. Doc.*, 1966, No. 47.
5. Taylor, A L., Dropkin, V. H. and Martin, G. C., *Phytopathology*, 1955, **45**, 696.
6. Yadav, B. S. and Naik, Labdev, S. M., *J. Sci. & Tech.*, 1966, **4** (3), 184.

PROPAGATION OF *BOUGAINVILLEA* BY STEM CUTTINGS

Bougainvilleas are generally propagated by means of cuttings or air-layerings, but they often fail to produce roots and the percentage of success is low even during the cultivated seasons. Investigations[1-6] have revealed varying degrees of success with the treatment of growth substances. The present investigation is an attempt to test the efficacy of different growth substances on the induction of rooting in a difficult-to-root variety of *Bougainvillea.*

Hard wood cuttings, 20–25 cm. long with uniform diameter, taken from the variety 'Mary Palmer' were treated with 100, 10 and 1 ppm aqueous solutions of indoleacetic acid (IAA), indolebutyric acid (IBA), naphthaleneacetic acid (NAA), 2, 4-dichlorophenoxyacetic acid (2, 4-D), maleic hydrazide (MH), gibberellic acid (GA_3), Seradix B_3 (a commercial formulation of May & Baker Ltd.) and control (distilled water) for 24 hours. The basal treated ends of the cuttings were thoroughly washed with distilled water and sown in unwashed sand as rooting media in glazed pots. The cuttings were planted during the winter months of the year (November to January).

The results are presented in Table I. A close analysis of the data shows that rooting was favourably improved by all the concentrations of IAA, IBA and NAA over the untreated controls. Seradix B_3 was found to be most effective, as the percentage of rooting, number and length of roots were much greater. 2, 4-D and MH in lower concentrations were responsive, whereas treatment with GA_3 had no effect or inhibited the production of roots. From the present investigation it thus appears that treatment with growth substances like IAA, IBA, NAA and Seradix B_3 may be utilized beneficially for the vegetative propagation of *Bougainvillea* during the adverse climatic conditions for rooting.

The author is grateful to Professor S. M. Sircar, Director, Bose Institute, Calcutta, and Professor A. K. Sharma, Head of the Department of Botany, University of Calcutta, for their keen interest.

TABLE I

Effect of growth substances on the rooting behaviour of Bougainvillea *stem cuttings*

Growth substances	Concentrations (ppm.)	No. of cuttings treated	No. of cuttings rooted	Per cent. of rooting	Mean No. of roots per cutting	Mean length of roots (cm.)
IAA	100	20	16	80	30·66 ± 2·78	15·17 ± 1·62
	10	20	8	40	21·20 ± 2·12	10·84 ± 1·40
	1	20	8	40	24·65 ± 2·24	10·92 ± 1·41
IBA	100	20	20	100	56·88 ± 2·68	13·16 ± 1·36
	10	20	20	100	48·95 ± 2·24	14·22 ± 1·42
	1	20	16	80	49·20 ± 2·26	12·07 ± 1·28
NAA	100	20	20	100	40·68 ± 2·14	12·62 ± 1·36
	10	20	12	60	36·72 ± 2·06	8·75 ± 1·06
	1	20	9	45	20·22 ± 1·01	8·87 ± 1·11
2, 4-D	100	20	0	0	..	..
	10	20	4	20	4·40 ± 0·48	2·72 ± 0·24
	1	20	8	40	7·98 ± 0·51	4·45 ± 0·29
MH	100	20	0	0	..	..
	10	20	0	0	..	..
	1	20	6	30	6·94 ± 0·55	3·13 ± 0·46
GA_3	100	20	0	0	..	..
	10	20	0	0	..	..
	1	20	3	15	1·48 ± 0·28	0·92 ± 0·28
Seradix B_3	Talc (Dip method)	20	20	100	60·20 ± 4·28	16·44 ± 1·56
Control	..	20	5	25	6·24 ± 0·68	3·22 ± 0·27

Dept. of Botany,
University of Calcutta,
Calcutta-19, *June* 4, 1970.

R. K. CHAKRAVERTY.

---

1. Lange, P., *Gartenwelt*, 1958, **58**, 376.
2. Mitra, G. C. and Bose, N., *Phytomorphology*, 1954, **7**, 370.
3. Mukhopadhaya, D. P. and Bose, T. K., *Indian J. Hort.*, 1966, **23**, 185.
4. Pillai, P. K., *Madras agric. J.*, 1963, **50**, 29.
5. Rao L. M., *J. Jap. Soc. hort. Sci.*, 1967, **36**, 445.
6. Soeparma, S. R., *Chron. Nat.*, 1949, **105**, 15.

REVIEWS AND NOTICES OF BOOKS

Quantitative Stereology. By Ervin E. Underwood. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London, W. 1, England), 1970. Pp. x + 274. Price *sh.* 117.

Stereology is the study of the structure of matter in three dimensions at the microscopic level, based on the examination of two-dimensional sections through the material. This book presents a unified and comprehensive treatment of the essential elements of stereological analysis. It provides, under one cover, the theoretical background to these methods, practical examples of their application, selected problems based on actual microstructures, and complete coverage of the literature. Thus it can be used as a text for college students at all levels, as a self-study guide, and as a reference work for a wide variety of research. The generalized, geometrical approach is designed to appeal equally to those engaged in metallurgy, petrology, mineralogy, and research in polymers or ceramics; to those studying microscopic anatomy, histopathology, botany or biology; and to those concerned with advancing the mathematics of statistics, geometrical probabilities, the theory of curves and surfaces, topology, and projective geometry.

C. V. R.

Annual Review of Plant Physiology (Vol. 21). (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1970. Pp. ix + 653. Price Postpaid: U.S.A. $ 10.00 and Foreign $ 10.50.

Volume 21 of this well-known series contains the following articles: 1. Prefatory Chapter: The Passing Scene; 2. Cell Organization: Biochemical Aspects of Chloroplast Development; Compartmentation of Intermediary Metabolites; Cell Wall Metabolism; 3. Nutrition and Absorption: Oxidation of Inorganic Nitrogen Compounds; Ion Transport in Chloroplasts and Plant Mitochondria; The Leaching of Substances from Plants; 4. Nitrogen Metabolism: Protein Synthesis in Plants; Fraction I Protein; 5. Bioenergetics: Physical Separation of the Photosynthetic Photochemical Systems; Photosynthetic CO_2-Fixation Pathways; Photorespiration; Photosystem II and O_2 Evolution; 6. General Metabolism: Biosynthesis of Cuticular Lipids; Regulation of Enzyme Activity in Photosynthetic Systems; 7. Translocation: Biochemistry and Fine Structure of Phlœm in Relation to Transport; 8. Growth and Development: Air Pollution Oxidants—Their Effects on Metabolic Processes in Plants; Cytokinins; Morphactins: Physiology and Performance; Gibberellins: Structure and Metabolism; 9. Special Topics: The Botanical and Chemical Distribution of Hallucinogens.

C. V. R.

Peptides: Chemistry and Biochemistry. Edited by Boris Weinstein and Saul Lande. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xv + 538. Price $ 19.50 or £ 9 6 *sh.* 0 *d.*

This book covers topics on classical and solid-phase peptide synthesis, theoretical and experimental studies of peptide conformation, correlations between structure or conformation with biological activity, isolation, characterization and synthesis of new peptide natural products, and synthesis of analogs.

The contributions are divided into four categories: peptide synthesis, relationships between structure and biological activity of peptides, racemization in peptide chemistry, and special problems in synthesis and analysis. Applications and development of new coupling reagents and techniques are described, including solid-state synthesis. Included is a discussion of the factors relating structure and activity in angiotensin, calcitonin, and secretin.

Other articles consider methods for detection, control, and study of the mechanism of racemization in peptide chemistry. Finally, work involving unusual amino-acids and peptides, antibiotics, cysting peptides, and γ-glutamyl peptides are also contained in the book.

The papers published in this volume were delivered at the first American Peptide Symposium held at Yale University, August 13–18, 1968. This conference brought together, for the first time in the United States, physical, organic, biological, and pharmaceutical chemists with a common interest in peptides. Publication of these proceedings makes available a permanent record of research in peptide chemistry for 1968, and may be of particular interest to scientists not present at the meeting.

The book will also be of value to chemists, biochemists, and physiologists who work with peptides and peptide hormones. C. V. R.

Handbook of Metal Ligand Heats and Related Thermodynamic Quantities. By James J. Christensen and Reed M. Izatt. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. vii + 324. Price $ 14.50 or £ 6 18 *sh.* 0 *d.*

Until now there has been no extensive compilation of heats of metal-ligand interactions in solution. This book provides a tabulation of this information.

One comprehensive table of heats for metal-ligand interactions in solution summarizes the published literature values up to mid-1969, and five indexes (author, empirical formula, element, synonym, and reference) provide cross-references to this table. Included in the book are the related thermodynamic quantities, log K and $\triangle S$, and $\triangle Cp$ values where available.

The book is a convenient reference source for workers in the areas of thermochemistry and thermodynamics of metal-ligand interaction, including those in such fields as chemistry, physics, bacteriology, engineering, microbiology, and medicine. It is especially directed to workers in the field of co-ordination chemistry.

C. V. R.

Carnegie Institution of Washington—Year-Book 1968. Pp. xii + 716. 25 plates, 234 figures. 1530, P Street, N.W., Washington D.C. 20005 (1970).

The Carnegie Institution of Washington with its six major departments functioning in different parts of the United States has been contributing in a significant manner to new knowledge in varied fields of scientific research. The Institution's *Year-Book* is a necessary addition to all science libraries.

Year-Book 68 covers the period from July 1, 1968 to June 30, 1969. It contains the annual address of the President, Prof. Caryl P. Haskins, his general report and the detailed reports from the various departments on their achievements and researches in progress.

Since the discovery just two years ago, of the first pulsating radio source by the radio astronomers of Cambridge, nearly fifty astronomical objects of this kind (pulsars)) have been detected. They emit sharply defined pulses (10–30 milliseconds) of radio energy at extraordinarily regular intervals. All these pulsars have so far been observed as to their radio pulse emission only. The first pulsar to be optically observed is the one designated NP 0532 in the Crab nebula. The report of the *Mount Wilson and Palomar Observatories* contains details of the optical observation and characterisation of NP 0532, using the prime-focus photometer of the 200-inch telescope at Palomar. The light of NP 0532 arises almost entirely from the short rapid light pulses emitted at the rate of 30 pairs per second. The two distinct and sharp pulses of the pair occur during each 33 msec period—a main 5 msec wide pulse followed, 13·5 msec later, by a secondary pulse somewhat wider but with a third of the amplitude and a half of the energy of the main pulse. It is interesting to note that this first optical pulsar is the very one that Baade and Minkowski at Mount Wilson in 1942 had suggested as the central star of the Crab nebula on the basis of its position near the centre of expansion and its spectroscopic peculiarity (a featureless blue continuum). Crab nebula has again become the chief centre of interest in modern astronomy.

The Geophysical Laboratory reports results of continued investigations in the fields of geochemical and petrological research. These are becoming increasingly fruitful on account of new techniques and instrumentation facilities that have become available. The report contains advances made during the year in petrography, phase-equilibrium studies, crystallography, biogeochemistry, age determinations of rocks, and mineralogy.

The measurement of strain changes in the earth's crust is fundamentally important to the understanding of earthquakes. In the report of the *Deparatment of Terrestrial Magnetism* is given the description and performance of a highly sensitive seismic instrument, namely, the prototype of a borehole strain rate meter installed at a depth of 150 ft. In essence, it consists of a water-filled resilient tube in intimate contact with the walls of a borehole. As the strain in the surrounding rock changes, the tube is deformed, forcing the liquid through a flow sensor device into an air space. This device is such that the minute distortions, down to 10^{-7} microns, are faithfully followed. The frequency of response covers a wide range of geophysical interests—from strain changes induced by microseisms, through those caused by microbarometric pressure influences on solid rock, to those resulting from the gravitational deformation of the earth by the moon (earth tides). Records of performance of the strain meter show its use on the timely prediction of major earthquakes to be very promising.

The Department of Embryology is devoted to the study of the processes of development in living organisms. The most important techniques in the current progress of embryology are interdisciplinary. Molecular biology and genetics are receiving increasing emphasis. The Department's researches during the year illustrate this trend not only in the application of molecular genetics but also in the use of virology to probe into developmental processes at cellular level.

The Department of Plant Biology reports new results in the field of photosynthesis especially with reference to the theoretical aspects of the problem, interrelating the pigments, enzymes, and intermediate compounds that make up the photosynthetic system. The Director of the *Genetics Research Unit* has presented a highly interesting and up-to-date survey on the relation of microbiological and biochemical genetics to classical genetic theory. A. S. G.

ANNOUNCEMENTS

Award of Research Degrees

Andhra University has awarded the Ph.D. degree in Chemistry to Shri P. Suryanarayana Murty.

Karnatak University, Dharwar, has awarded the Ph.D. degree in Chemistry to Shri G. V. Patil.

M.S. University of Baroda has awarded the Ph.D. degree in Chemistry to Shri M. Venkatnarva Reddy; Ph.D. degree in Biochemistry to Kumari Veena Jashwantlal Shah, Shri Suresh Rudra Nadkarni, Shri Dineshkumar Jayantilal Parikh and Kumari Bhadrashila Ishwarlal Naik; Ph.D. degree in Zoology to Shri Davindra Kumar Magon.

Osmania University, Hyderabad, has awarded the Ph.D. degree in Chemistry to Shri S. Ramachandra Moorty.

Sri Venkateswara University, Tirupati, has awarded the Ph.D. degree in Zoology to Shri J. V. Ramana Rao.

Third Conference on Photographic Science and Technology

The Third Conference on Photographic Science and Technology will be held on 15 and 16 April 1971 at Indunagar, Ootacamund-5. For further details please contact The Secretary, Hindustan Photofilms Mfg. Co. Ltd., Indunagar, Ootacamund-5.

Nuclear Physics and Solid State Physics Symposium

The Nuclear Physics and Solid State Physics Symposium organised by the Physics Committee, Department of Atomic Energy, will be held at the Madurai University, Madurai, on December 27-30, 1970. Further information can be had from Dr. S. S. Kapoor, Secretary, Nuclear Physics and Solid State Physics Symposium, BARC, Trombay, Bombay-85.

Books Received

From: (Addison-Wesley Pub. Co., West End House, 11, Hills Place, London W. 1, England).

A Radical Approach to Algebra. By M. Gray, 1970. Pp. viii + 232. Price 98 *sh.*

Fundamentals of Geometry. By B. E. Meserve and J. A. Izzo, 1970. Pp. vii + 246. Price 93 *sh.*

The Process of Biology Primary Sources. By J. J. W. Baker and G. E. Allen, 1970. Pp. viii + 380. Price 43 *sh.*

Mathematics Creation and Study of Form. By J. P. Evans, 1970. Pp. x + 358. Price 61 *sh.*

Particles and Their Interactions. By J. G. Powles, 1970. Pp. xii + 260. Price 47 *sh.*

Elements of Precalculus Mathematics. By D. M. Dribin, 1970. Pp. xiii + 274. Price 70 *sh.*

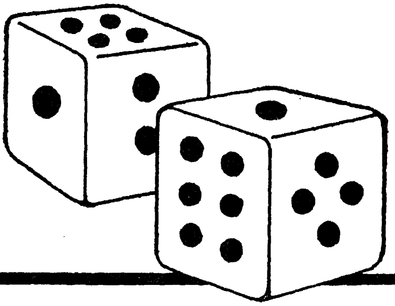
Elementary Geometry for Teachers. By M. M. Ohmer, 1970. Pp. 152. Price 52 *sh.*

Probability and Calculus—A Brief Introduction. By J. B. Fraleigh, 1970. Pp. vi + 250. Price 75 *sh.*

Elementary Mathematics for Teachers. By C. F. Brumfiel and E. F. Krause, 1970. Pp. x + 436. Price 91 *sh.*

2296-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, at The Bangalore Press, Bangalore-18.

**DON'T
GAMBLE
ON QUALITY**



WHERE QUALITY IS YOUR CRITERION

insist on Guaranteed Reagents by **SARABHAI M. CHEMICALS**
for your Chemical Analysis and Research.

SARABHAI M. CHEMICALS LTD.
Post Box No. 80, Wadi Wadi, Baroda

Shilpi SM 32/70

FOR YOUR REQUIREMENTS OF

AGAR AGAR I. P., U. S. P.

SHREDS (Snow-White) or **POWDER**

Please contact :

Indian Agar Private Limited
Post Box 27
Industrial Estate
KOVILPATTI
Tamil Nadu

**Journal of the
INDIAN BOTANICAL SOCIETY**

The J. Indian bot. Soc. *is a QUARTERLY
now running Volume* 49 (1970)

The Annual Subscription is Rs. 30.00 or £ 2-10-0 or $7.50 for a complete volume of four numbers.

BACK NUMBERS of the Journal and SPECIAL PUBLICATIONS, such as History of Botanical Researches in India, Burma & Ceylon (Parts I, II & III) and MEMOIRS 1, 2 & 3 of the Society are available.

For Particulars and Prices, Please write to :
BUSINESS MANAGER & TREASURER
Indian Botanical Society
Department of Botany
Andhra University
WALTAIR

NON-EQUILIBRIUM SOLIDIFICATION IN A PERITECTIC SYSTEM

S. N. TIWARI, S. L. MALHOTRA AND T. R. ANANTHARAMAN

Department of Metallurgy, Institute of Technology, Banaras Hindu University, Varanasi

ABSTRACT

Lead-bismuth alloys were subjected to a wide range of non-equilibrium solidification rates and studied by standard optical and X-ray metallographic techniques. In the light of the results, a modified peritectic solidification mechanism has been suggested.

INTRODUCTION

THE solidification of a liquid, through a peritectic reaction, *e.g.*, $\alpha + L \rightarrow \beta$ in a binary system, has received very little attention despite the fact that this reaction is extremely common in metallic systems. The peritectic reaction has been recognized[1] as a means of effecting grain refinement in alloys and also as a method of growing intermetallic compounds with special properties. Description of the peritectic reaction given in most metallurgical text-books, with the exception of few,[2,3] are in terms of maintaining equilibrium conditions during the solidification process, a requirement that is almost impossible of fulfilment in practice. Recently, some peritectic systems have been studied[4-7] under non-equilibrium solidification conditions. With a view to understand the impact of the rate of solidification on the mechanism of peritectic reaction and also to explore the possibility of predicting the morphology of the constituents in alloys of a peritectic system solidifying under non-equilibrium conditions, we have embarked on some detailed solidification studies of the lead-bismuth system[8] featuring the peritectic reaction (Fig. 1). The preliminary results presented here concern solidification of three alloys, each under four different non-equilibrium cooling conditions.

EXPERIMENTAL PROCEDURES AND RESULTS

Pb-Bi alloys of three compositions, *i.e.*, 15, 26 and 37 wt.% bismuth, one of them undergoing the peritectic reaction on cooling according to the phase diagram and the other two with compositions on either side of the peritectic horizontal, *i.e.*, one to the left of A and the other to the right of C in Fig. 1, were chosen for the present study. Lead and bismuth of more than 99·9% purity were used in preparing the charges. The loss in weight after melting was always negligible.

Many different techniques of melting and solidification were used in preparing the alloy specimens. Calculated amounts of the two metals were generally weighed out for 100 g. charges and melted in corning glass tubes. The melts were thoroughly agitated to effect homogenization and then the tubes were cooled in a furnace from 350° C. to room temperature. Melts prepared in the above manner were also cooled in a jet of compressed air, directed at the bottom of the glass tubes. In another variation of this technique, 100 g. charges of the required compositions were sealed in evacuated pyrex glass capsules, heated in a furnace up to 350° C., homogenized by thorough mixing of the melt and eventually chilled in water.

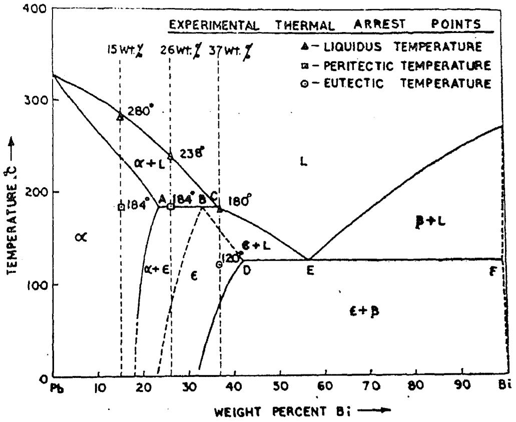


FIG. 1. Phase diagram of Pb–Bi system indicating experimental thermal arrest points. (Equilibrium Peritectic Horizontal: Temperature 184° C.; Compositions—**A**, 23·5%; **B**, 33·4%; **C**, 36·2%. Equilibrium Eutectic Horizontal: Temperature 125° C.; Compositions—D, 42·0%; **E**, 56·5%; **F**, 99·5%.)

The novel splat-cooling technique of extremely rapid quenching from the liquid state was also used in our studies. The apparatus employing the so-called gun technique was similar to the one, developed by Duwez and Willens[9] and has been described in detail elsewhere.[10,11] In each experiment about 20-30 mg. of the alloys prepared by the conventional melting technique were heated up to 350° C. in a graphite crucible, splat-atomized by a shock wave induced by nitrogen gas under high pressure and quenched on to a copper substrate.

Cylindrical samples were cut from the ingots solidified under different cooling rates. They were polished and examined metallographically, adopting the usual precautions for good surface finish and using a 5% aqueous solution of silver nitrate as etchant. In case of splat-cooling experiments, the very thin foils obtained by quenching did not require any metallographic preparation.

To identify and confirm the phases present, all samples were subjected to X-ray examination. Fine splat flakes were collected and mounted on a thin glass fibre with the help of 'Quick fix' to make suitable X-ray specimens. Similarly specimens were prepared from the fine powder obtained by filling the cylindrical samples. The Debye-Scherrer patterns were obtained. using a 114·6 mm. dia. Philips camera with nickel-filtered Cu Kα radiation. The observed interplanar spacings were compared with the calculated ones and thus the phases were identified.

To gain further understanding of the solidification processes under different cooling rates, thermal analysis was conducted on all the alloys. Required quantities of the two pure metals were weighed out for 500 g. charges and melted in an alumina crucible placed in a resistance-heated furnace. Cooling curves were obtained on furance cooling with the aid of a continuous temperature recorder, using standard chromel-alumel thermocouples enclosed in stainless steel sheaths.

The thermal arrest points obtained in case of each alloy are shown in Fig. 1. A summary of the microstructural and X-ray observations are given in Table I. The departure from equilibrium is pronounced for all rates of solidification employed in the present work.

as per phase diagram (Fig. 1). As the temperature further falls, more of α will solidify either through growth of the original nuclei or through formation of more α crystals. In the temperature range from the liquidus to the peritectic reaction, the amount of the primary α will continue to increase and its composition change according to the solidus as modified for the non-equilibrium conditions. During the process of solidification, the α crystals will reject bismuth at the interface and thus, as the temperature falls, the composition of the liquid adjacent to α crystals will become correspondingly richer in bismuth. Thus there will be a layer of constitutionally super-cooled liquid, surrounding the primary α crystals. The above condition of under-cooling, ahead of the interface, may be considered suitable for producing a dendritic morphology (Figs. 2, *a*, *b*). The various branches of the α dendrites will grow until inhibited in the lateral direction by other similar dendrites. The morphology of the α-phase will, however, depend on the temperature gradient and the solidification rate. If the temperature gradient is steep and the solidification is high, there will only be a narrow region of under-cooled liquid into which the dendrites can grow. The time allowed for growth in the lateral direction will be short and this will result in fine dendrites. It can be seen that dendrites are much finer in the splat-cooled structure (Fig. 2, *b*) than in the air-cooled one (Fig. 2, *a*).

When more and more of α crystals are formed during solidification and the liquid between these crystals becomes more and more enriched in bismuth, the composition of the liquid may well reach C (Fig. 1). In such an extreme non-equilibrium situation, ϵ crystals may nucleate and grow as a result of the peritectic reaction and/or direct solidification. The resulting solid would then be two-phase, consisting of α and ϵ. On further cooling to room

TABLE I

Microscopic and X-ray evidence for the phases in lead-bismuth alloys

Solidification condition	Pb-15 wt.% Bi alloy		Pb-26 wt.% Bi alloy		Pb-57wt. % Bi alloy	
	Microscopic evidence	X-ray evidence	Microscopic evidence	X-ray evidence	Microscopic evidence	X-ray evidence
Equilibrium cooling ..	α	α	ϵ	ϵ	$\epsilon+\beta$	$\epsilon+\beta$
Furnace cooling ..	$\alpha+\epsilon$	$\alpha+\epsilon$	$\alpha+\epsilon+$E	$\alpha+\epsilon+\beta$	$\epsilon+$E	$\epsilon+\beta$
Air cooling ..	$\alpha+\epsilon$	$\alpha+\epsilon$	$\alpha+\epsilon$	$\alpha+\epsilon+\beta$	$\epsilon+$E	$\epsilon+\beta$
Water cooling ..	$\alpha+\epsilon$	$\alpha+\epsilon$	$\alpha+\epsilon$	$\alpha+\epsilon+\beta$	$\epsilon+$E	$\epsilon+\beta$
Splat cooling ..	$\alpha+\epsilon$	$\alpha+\epsilon$	$\alpha+\epsilon$	$\alpha+\epsilon+\beta$	$\epsilon+\beta$	$\epsilon+\beta$

α, Solid solution of bismuth in lead; ϵ, Intermediate phase; E, Eutectic mixture of ϵ and β; β, Solid solution of lead in bismuth.

DISCUSSION OF RESULTS

(i) Solidification of Lead-15 wt.% Bismuth Alloy.—When this alloy is cooled to its liquidus temperature, nucleation of α crystals will occur

temperature, precipitation of ϵ may also take place within the α crystals. This is precisely what we have observed in our alloys on increasing the rate of solidification.

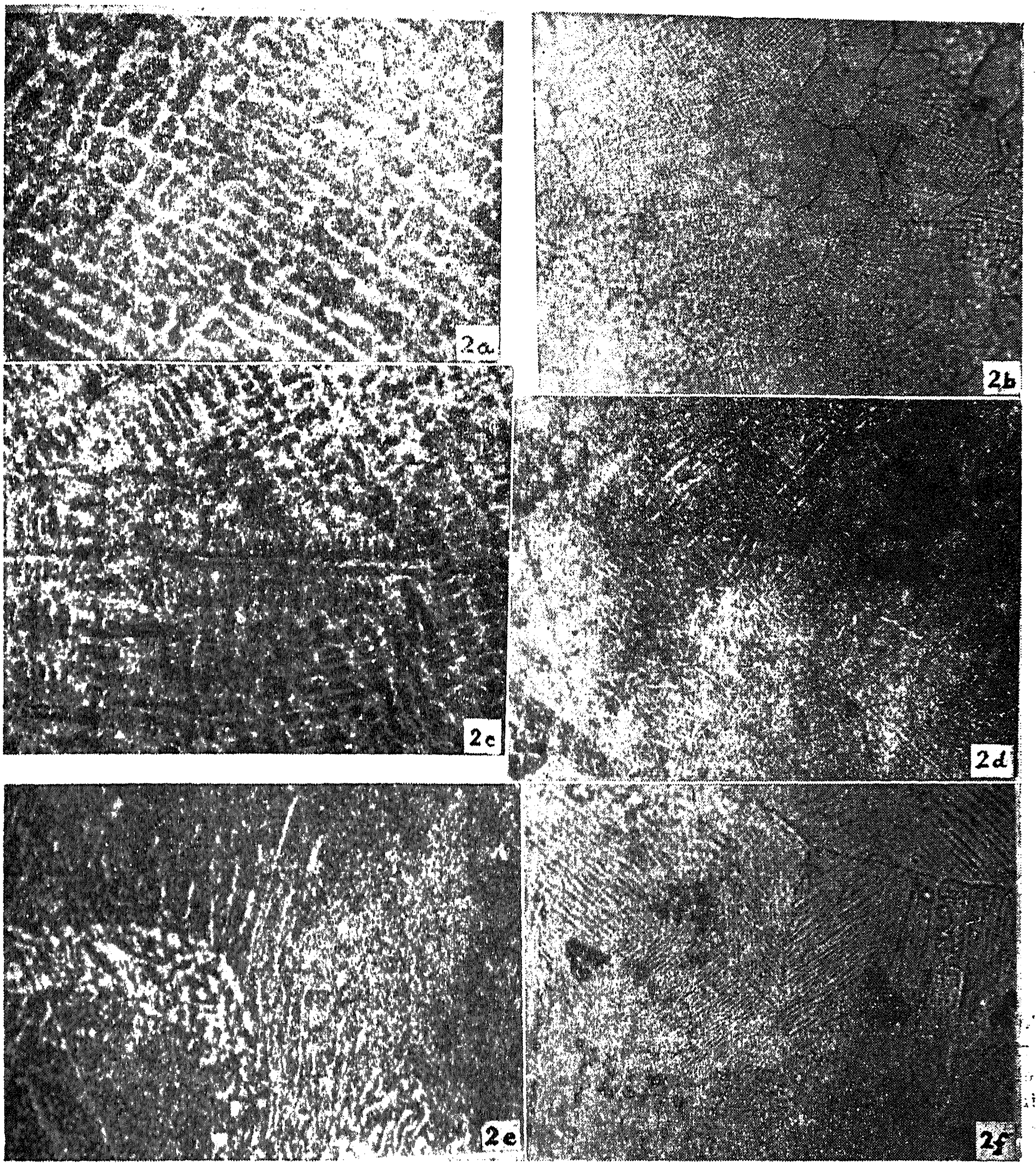


FIG. 2. Photomicrographs of Pb–Bi alloys. (*a*) 15 wt.% Bi, air-cooled, × 200; (*b*) 15 wt.% Bi, splat-cooled, × 750; (*c*) 26 wt.% Bi, furnace-cooled, × 50; (*d*) 26 wt.% Bi, furnace-cooled, × 200; (*e*) 37 wt.% Bi, furnace-cooled, 350; (*f*) 37 wt. % Bi, splat-cooled, × 750.

(ii) *Solidification of Lead-26 wt.% Bismuth Alloys.*—In case of this alloy, on cooling from the molten state to nearly the peritectic temperature, the process of solidification will be more or less the same as discussed above. At the peritectic temperature, the α-phase may react with the liquid to give the peritectic product ϵ. But this reaction will occur only to a very limited extent, unless very long times are available during freezing and subsequent cooling to convert the α-phase completely to the ϵ-phase. In practice, therefore, the α-phase will persist even in the peritectic alloy, although it is not an equilibrium phase (Fig. 2, *c*). Because of the limited nature of the reaction, it is quite possible that on further cooling some of the unreacted liquid may directly precipitate ϵ-phase, thereby increasing the bismuth content of the remaining liquid beyond C. In such an extreme case, the liquid will eventually solidify as a eutectic mixture of ϵ and β in some areas. Even in furnace-cooled samples, such a eutectic structure was actually seen by us in some areas (Fig. 2, *d*).

(*iii*) *Solidification of Lead-37 Wt.% Bismuth Alloy.*—In this case, under equilibrium cooling, the solid at room temperature should consist essentially of the ϵ-phase with some precipitation of β in each ϵ grain. But under non-equilibrium conditions, it is possible that, due to the very rapid rise in the bismuth content of the liquid, as freezing approaches completion, a small portion of the liquid may reach the eutectic composition and solidify as the eutectic. The structure at room temperature will then consist of grains of ϵ, along with the eutectic mixture of ϵ and β at the grain boundaries (Fig. 2, *e*).

In splat-cooled samples of all compositions, a two-phase dendritic and/or a cellular structure would be observed under the optical microscope (Figs. 2, *b* and *f*). Our results agree with those of Borromee-Gautier *et al.*[5] in that no new phases were observed in the composition range studied. The single-phase structure, obtained in some cases by them,[5] may be explained as due to the facts that their splat-cooling rates were perhaps faster and all their studies were carried out at – 190° C. and not at room temperature, as in our case.

(*iv*) *The Mechanism of Peritectic Solidification.*—Under equilibrium coolings, the ϵ-phase is expected to form in alloys of the peritectic composition range of the Pb-Bi system as a result of the following simple peritectic reaction:

$$\alpha + L \to \epsilon.$$

The reaction product ϵ will form at the interface between α-phase and the liquid, enveloping thereby the α crystals. As a result, a ring structure should generally be obtained. The present study shows, however, that no such structure forms as a result of the peritectic reaction, in cases of departures from ideal equilibrium conditions. Obviously, the above reaction occurs in practice only to a very limited degree, the extent of the reaction depending very much on the cooling conditions. With even furnace cooling, this reaction seems to occur to a very small extent. At such cooling rates, one may or may not observe the thermal arrest point. In case of furnace cooling, the thermal arrest point was indeed observed, though not as marked as the eutectic arrest point. Under more or less similar conditions, no ring structure was observed under the microscope. It can thus be concluded that for all practical purposes the conventional peritectic reaction hardly takes place and can be ignored.

According to our observations, at the peritectic temperature, ϵ does not seem to form by the peritectic reaction between α and the liquid, but rather forms by direct precipitation from the liquid enriched in bismuth, as the alloy is cooled through the peritectic temperature. Because of the direct precipitation of ϵ, the remaining liquid may well get enriched in bismuth content even beyond C (Fig. 1) and thus give rise to a eutectic product on further cooling. Thus, under non-equilibrium cooling conditions, the entire peritectic solidification may be postulated to take place in the following manner:

$$L \to x.\alpha + y.L \to p.\alpha + q.\epsilon + r.L \to a.\alpha + b.\epsilon + c\beta.$$

where x and y, p, q and r as well as a, b and c represent mole fractions that will vary according to the cooling condition as well as the alloy composition. In practice, the values of x, p and a seem to be of the same order.

The mechanism proposed above explains the presence of the eutectic (Fig. 2, *d*) in hypoperitectic alloys, as clearly established metallographically and verified by X-ray analysis in the present work. Such a peritectic solidification mechanism should be helpful in rationalising non-equilibrium solidification phenomena in alloys of peritectic systems.

1. Sartell, J. A. and Mack, D. J., *J. Inst. Metals*, 1964, **93**, 19.
2. Chalmers, B., *Physical Metallurgy*, John Wiley, New York, 1959, p. 271.
3. Rhines, F. N., *Phase Diagrams in Metallurgy*, McGraw-Hill, New York, 1956, p. 85.
4. Unlmann, D. R, and Chadwick, G. A., *Acta Met.*, 1961, **9**, 835.
5. Borromee-Gautier, C., Giessen, B. C. and Grant, N. J., *J. Chem. Phys.*, 1968, **48**, 1905.
6. Klement, W. Jr. and Luo, H. L., *TMS-AIME*, 1963, **227**, 1253.
7. —, *Ibid.*, 1963, **38**, 298.
8. Hansen, M., *Constitution of Binary Alloys*, McGraw-Hill, New York, 1958, p 324.
9. Duwez P and Willens, R. H., *TMS-AIME*, **1963**, **227**, 392.
10. Ramachandra Rao, P., Rama Rao, P. and Anantharaman, T. R., *Z. Metallkde.*, **1970**, **61**, **471**.
11. Suryanarayana, C. and Anantharaman, T. R., *Curr. Sci.*, 1958, **37**, 631.

CLADOCERAN SWARM IN RELATION TO MACKEREL FISHERY ALONG THE WEST COAST OF INDIA

R. ALFRED SELVAKUMAR
National Institute of Oceanography, CSIR Panaji (Goa)

THE Indian mackerel, *Rastrelliger kanagurta* (Cuvier), is one of the most important commercial fishes. On an average about 10% of the total marine fish catches from the Indian Coast include mackerel, of which about 98% is landed on the west coast. Fluctuations in the landings of mackerel are well known from year to year, the causes of which are still not properly understood. On the west coast of India the mackerel is caught from Ratnagiri to Quilon, but the major concentrations occur between Ratnagiri and Cochin. The actual fishing season lasts from August to March. Mackerel appears earlier in the south and late during the season northwards. Their movements from north to the south also follow a similar pattern (Panikkar, 1952).[1] The appearance of mackerel seems to be associated with the south-west monsoon.

TABLE I

Showing the relationship between the cladoceran peak and the mackerel fishery period along the west coast of India as observed by various authors at different localities

Mackerel fishing season	Locality	Period of cladoceran abundance and its peak	Author
July/August to February ..	Trivandrum	July to October peak at July	Menon, M. A. S. (1945)
August to March ..	Cochin	July to September peak at August	George, M. J. (1958)., Menon, N. R., Venugopal, P. and Goswami, S. C. (1969)
August/September to March/April	Calicut	July to November peak at August	George, P.C. (1953)
September/October to March ..	Karwar	August to February peak at September/October	Noble, A. (1962), Ramamurthy, S (1965)
October to March ..	Panaji (Goa)	September to February peak at October	Selvakumar, R. A. (Unpublished)

Mackerel is a plankton feeder and its movement in dense shoals in the inshore waters during the post-monsoon season is associated with the availability of plankton in abundance during that period (Panikkar, 1952: Bhimachar and George, 1952[2] and Noble, 1962).[3] Subrahmanyan (1959)[4] has stated that the outburst of phytoplankton depends upon the outbreak of monsoon from south towards north. The peak in the zooplankton abundance occurs during the south-west monsoon season, immediately after the phytoplankton bloom. During this period, usually the smaller zooplankton such as copepods, cladocerans, tintinnids and larvæ of several groups predominate. Subrahmanyan (1959) also observed that on certain occasions when the phytoplankton is composed mainly of setoid forms like *Chætoceros* sp., *Bacteriastrum* sp., *Rhizosolenia* sp., etc., a fall in the zooplankton biomass occurs. Thus an interrelationship between the occurrence of setoid forms and the appearance of smaller zooplankton organisms such as cladocerans is evident.

The association of cladoceran swarm with the onset of mackerel fishery was studied by the author based on the observations made at Karwar during the 1966 fishing season and at Goa in 1969 season. A review of earlier studies clearly indicates the relationship as given in Table I. Karwar and Goa fall along mackerel fishery belt where very high catches are recorded. In 1966, the cladoceran swarm was noticed in the plankton at Karwar during the first week of October. Soon after the swarm, the mackerel shoals were sighted inside the bay and the first "*rampan*" net was operated for mackerel on 9-10-1966. Similarly, during 1969, the cladoceran swarm was observed in the plankton in the coastal waters of Goa in the third week of October and within a week heavy catches of mackerel were landed. The cladocerans referred to here were *Evadne tergestina* Claus. and *Penilia avirostris* Dana. Amongst the cladocerans *Evadne* appeared earlier and was greater in abundance than *Penilia* in the plankton both at Karwar and at Goa. This seems to confirm the observations made by George (1953)[5] at Calicut and Ramamurthy (1965)[6] at Karwar.

A review of the report on food and feeding habits of mackerel suggests a possible trophic relationship between mackerel and cladoceran in the coastal waters. It is known (Pradhan, 1956)[7] that only the juvenile mackerel of size 18–22 cm. contribute mostly to the commercial catches in the post-monsoon months. Bhimachar and George (1952) have observed that the cladocerans formed a substantial part of the diet of juvenile mackerel during the period August to December and it is during this period that the cladocerans are abundant in the plankton. Noble (1962) has observed maximum cladocerans in the stomachs of mackerel during September, when *Evadne* was dominant in the plankton. Menon (1945)[8] reported from the Trivandrum coast that the cladocerans have a maximum abundance from July to October.

This relationship becomes more certain when temperature and salinity data during the cladoceran maxima and mackerel fishery period are examined. Cladoceran abundance in the plankton off Calicut is recorded when the temperature and salinity ranged between 24·4–26·5° C. and 30·5–33·3‰ (George, 1953). Similarly, in the Cochin region *Evadne* was observed in large numbers in the plankton from July to September when salinity was low (George, 1958).[9] Ramamurthy (1965) has observed that the cladocerans constituted a major group in the coastal plankton during the later half of the south-west and early north-east monsoon (August-November) and that *Evadne* appear to prefer a lower salinity (16·17–30·94‰) than *Penilia* (29·0–33·56‰) whereas the corresponding temperature is 26·0–27·6° C. for *Evadne* and 26·5–28·0° C. for *Penilia*. Recently, Menon, Venugopal and Goswami (1969)[10] found that the cladoceran abundance is maximum near the Cochin harbour in August and September when the salinity is low.

At Goa, during October 1969, when the cladoceran swarm occurred, it was noted that the conspicuous phytoplankton were setoid forms such as *Chætoceros* sp., *Thallassiothrix* sp., *Nitzschia* sp. and *Ceratium* sp. So a possible association seems to exist between these four forms and cladocerans.

Both *Evadne* and *Penilia* were equally abundant during the third week of October 1969, at Goa, the average temperature, salinity and oxygen were 28·0° C., 32·00‰ and 3·50 ml./l. respectively. From the table given by Ramamurthy (1965) it is evident that the cladocerans are absent during the period of south-west monsoon. They appear in August and reach their peak abundance in October. This peak obviously coincides with the onset of the mackerel fishing, which as reported earlier by Pradhan (1956) starts in October at Karwar, whereas Noble (1962) observed the cladoceran peak in September at Karwar.

The occurrence of peak abundance of *Evadne* and *Penilia* which follow the phytoplankton bloom appears to be associated with the favourable water temperature and salinity of 26–28° C. and 27–32‰ respectively in the waters of west coast as observed by various authors. There is enough reason to propose that the appearance of cladoceran swarm and their progressive movement from south to north heralds the mackerel shoals.

Further investigations on the occurrence and growth of cladoceran forms in association with phytoplanktonic elements constituting the plankton crop in the coastal waters is in progress which would render more evidence towards the proposed correlation.

ACKNOWLEDGEMENT

The author wishes to thank Dr. N. K. Panikkar, Director, National Institute of Oceanography, Panaji (Goa), for his encouragement and guidance in the present investigation and to Dr. S. Z. Qasim, Shri R. Jayaraman and Dr. P. V. Dehadrai, Scientists of the Institute, for critically going through the manuscript and offering helpful suggestions.

---

1. Panikkar, N. K., *J. Bombay nat. Hist. Soc.*, 1952, **50**, 741.
2. Bhimachar, B. S. and George, P. C., *Proc. Ind. Acad. Sci.*, 1952, **36** (3), 105.
3. Noble, A., *Indian J. Fish.*, 1962, **9** (2), 701.
4. Subrahmanyan, R., *Proc. Ind. Acad. Sci.*, 1959, **50**, 113, 189.
5. George, P. C., *J. Zool. Soc. India*, 1953, **5** (1), 76.
6. Ramamurthy, S., *J. Mar. biol. Ass. India*, 1965, **7** (1), 127.
7. Pradhan, L. B., *Indian J. Fish.*, 1956, **3** (1), 141.
8. Menon, M. A. S., *Proc. Ind. Acad. Sci.*, 1945, **22** (2), 31.
9. George, M. J., *Indian J. Fish.*, 1958, **5** (2), 375.
10. Menon, N. K., Venugopal, P. and Goswami, S. C., *Abstracts, First All-India Symposium in Estuarine Biology*, Madras, 1969.

THE MORPHOLOGY OF COPPER ELECTRODEPOSITED FROM ACID COPPER SULPHATE BATH WITH Cl^- IONS ON COPPER (110) FACE

S. NAGESWAR AND T. H. V. SETTY

Department of Chemistry, Central College, Bangalore University, Bangalore

ABSTRACT

Studies of copper electrodeposits, on to the (110) plane of copper was made from highly purified solutions of copper sulphate containing known concentration of HCl from 10^{-10} to 10^{-1} m./L. In presence of small amounts of HCl the morphology was not affected but deposition was facilitated. At higher concentration of HCl, CuCl was included in the deposit giving rise to polycrystalline deposit.

INTRODUCTION

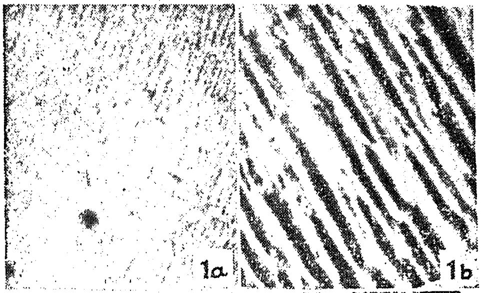
THE morphology of copper electrodeposits deposited on copper single crystal faces from pure acid copper sulphate bath has been studied.[1-4] It was observed that the morphology of deposit was influenced by the crystallographic orientation and bath conditions. Generally pyramids, layers and ridge type of growth were observed depending upon the substrate orientation and current density when deposited from very pure solutions. It was shown that the chloride ions present in bath modify the growth forms of copper electrodeposited on copper (100) face.[5] The present work was extended to study the effect of chloride ions on the morphology of copper electrodeposits deposited on (110) plane of copper.

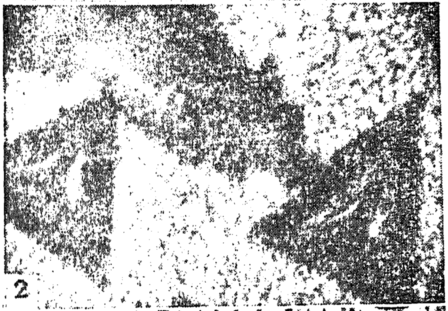
The (110) plane was mechanically polished on emery-paper finishing with 4/0 and then electropolished in 1 : 1 H_3PO_4. The deposition was carried out at various current densities (*cd*) on the plane from 0·25 M $CuSO_4$ + 0·1 M H_2SO_4 bath with a known amount of freshly distilled HCl. The thickness of the deposit was 10 C./cm.^{2} (3·5 μ) in almost all cases. The deposit was examined under a metallurgical microscope and photomicrographs were taken. The other experimental details have been described earlier.[5]

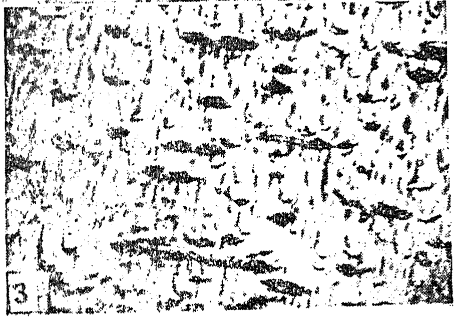
RESULTS AND CONCLUSIONS

A ridge type of deposit was observed when copper was deposited from pure acid copper sulphate bath at all *cd* studied (2, 5, 10, 15 and 20 mA./cm.^{2}) as noticed by earlier workers.[2-4] These ridges were aligned parallel to [100] directions at 2 and 5 mA./cm.^{2}, whereas they were aligned parallel to [110] direction at or above 10 mA./cm.^{2} as observed earlier[2] and as shown in Figs. 1 (*a*) and (*b*). It was also noticed that the size of the ridges were bigger when deposited at higher *cd* (20 mA./cm.^{2}, Fig. 1 *b*).

The chloride ions would not affect the type of growth upto a concentration of 10^{-4} m./L of HCl at all *cd*. However, the direction of the ridges at or above 10 mA./cm.^{2} changed from [110] direction to [100] direction at 10^{-6} m./L of HCl, *i.e.*, the direction of the ridges would be the same as those obtained at 5 mA./cm.^{2} from very pure solution. The deposit obtained at 7·5 mA./cm.^{2} from pure solution showed that ridges were growing in both directions (Fig. 3). The ridges obtained at 7·5 mA./cm.^{2} from pure







FIGS 1–3. Fig. 1. (*a*) Ridges parallel to [100] direction when copper was deposited on Cu (110) from acid copper sulphate bath at 5 mA/cm.^{2}, × 500. (*b*) Ridges parallel to [110] direction when deposited at 20 mA/cm.^{2}, × 500. Fig. 2. Polycrystalline deposit with CuCl on (110) from acid copper sulphate bath in presence of 10^{-4} m/L HCl at 5 mA/cm.^{2}, × 500. Fig. 3. Ridges growing in two directions when deposited at 7·5 mA/cm.^{2} on Cu (110) from acid copper sulphate bath, × 500.

solution at various thicknesses were examined. Upto 6 C./cm.^{2} the ridges were aligned along [100] direction only. At 8 C./cm.^{2}, ridges along [100] began to fade out and ridges along [110] direction began to grow. Above 15 C./cm.^{2} only ridges aligned along [110] were observed.

At 10^{-4} m./L of HCl the ridges broke up to small flat ridges. On further increase of the concentration of HCl to 10^{-2} m./L triangular pyramids of CuCl precipitated out during deposition as noticed in the case of [100] plane and a matty dull polycrystalline type of deposit resulted (Fig. 2). This transition from ridges to polycrystalline deposit was noticed at all *cd.*

The overpotential on [110] plane was always lower than on [100] plane at any corresponding *cd.* The overpotential remained constant with time except for the initial period at 2, 5, 10 and 20 mA./cm.^{2} but at 7·5 mA./cm.^{2} it increased upto a thickness of 8 C./cm.^{2} and then remained steady. The Tafel slope was 110 (± 5) mv. which shows that the r.d.s. is the charge transfer of first electron.[6] The presence of chloride ions upto a concentration of 10^{-6} m./L did not affect the value of overpotential but at 10^{-6} and 10^{-5} m./L of HCl the overpotential was very much lower than those from pure solution. For instance, the overpotential at 10 mA./cm.^{2} in pure solution was 110 (± 5) mv. whereas it was 70 (± 5) mv. at the same *cd* in presence of 10^{-6} m./L of HCl. This value of overpotential obtained in presence of chloride ions was nearer to the value of overpotential obtained at 5 mA./cm.^{2} from pure solutions. However, the Tafel slope did not change at that concentration.

When the concentration of HCl was increased further (10^{-4} m./L) the overpotential was higher than those obtained from pure solutions at corresponding *cd.* The Tafel relationship does not hold good at these concentrations of HCl as noticed by Bockris *et al.*[6]

It is noticed that the direction of ridges changes at higher *cd* from [100] to [110] in pure solution but in presence of chloride ions the direction of ridges would only be [100] even at higher *cd.* A close examination of overpotential indicates that the ridges align in [110] direction if the overpotential is below 100 mv. and in [110] direction when the overpotential is more than 100 mv. This idea is also supported by the fact that the overpotential at 7·5 mA./cm.^{2} in pure solution was between 75 and 100 mv when ridges aligned in both directions were observed. Some further experiments were carried out to test whether the direction of alignment of ridges really depends upon the overpotential.

It was observed that the presence of chloroacetic acid in copper sulphate bath increases the overpotential at all *cd* when deposited on (100) plane of copper.[7] Therefore the deposition of copper on copper (110) face was carried out from acid copper sulphate bath in presence of chloroacetic acid. It was observed that the overpotential would be more than 100 mv. even at 5 mA./cm.^{2} when the chloroacetic acid content was 10^{-2} m./L. It was also further observed that the ridges grew along [110] direction. This conclusively proves that the overpotential decides the direction of alignment of ridges.

It is known that chloride ions are highly polarisable anions and so they get specifically adsorbed on the surface. This adsorption of chloride ions may facilitate the incorporation of copper adions into crystal lattice along (100) direction without altering r.d.s. as indicated by Tafel slope. This shows that incorporation of adions is easier along [100] direction compared to [110] direction as expected since atomic density along [100] is lower than along [110]. At concentration higher than 10^{-4} m./L. of HCl the transition from ridge type of growth to random type growth takes place and CuCl precipitates out. It is possible therefore to assume that CuCl begins to get precipitated at growing centres of the plane and this obstructs the easy incorporation of copper adions as indicated by the increase of overpotential. The only alternative for copper adions is to nucleate randomly and grow which results in polycrystalline deposit.

Thus it could be concluded that the lower concentration of chloride ions facilitates the deposition without affecting the habit but higher concentration will affect the growth habit of deposition because of the inclusion of CuCl.

ACKNOWLEDGEMENT

The authors are grateful to Prof. F. X. Sutman, Professor of Education, Temple University, Philadelphia, U.S.A., for the gift of copper single crystals.

---

1. Damjanovic, A., Paunovic M. and Bockris, J. O'M., *J. Electroanal. Chem*, 1965, **9**, 93.
2. —, Setty, T. H. V. and Bockris, J. O'M., *J. Electrochem Soc.*, 1966 **113** 429.
3. Seiter Fischer and Albert, *Electrochem. Acta*, 1960, **2**, 167
4. Pick, H J., Storev G. G. and Vaughen, T. B., *Ibid.* 1960 **2**, 165.
5. Nageswar S. and Setty, T. H. V., *Proc. Ind. Acad. Sci*, 1968 **68**, 178.
6. Bockris, J O'M and Envo, M., *Trans. Faraday Soc*. 1962. **58**, 87
7. Seshadri, B. S. and Setty, T. H. V., Unpublished work.

LETTERS TO THE EDITOR

THE VISIBLE EMISSION SPECTRUM OF THE CaBr MOLECULE

THE emission spectrum of CaBr molecule is known to consist of five discrete band systems[1-5] in the region λλ 6400-2900 Å designated as A-X, B-X, C-X, D-X and E-X. Of these, the first four systems were observed both in emission and absorption while the E-X system was observed only in emission. From the vibrational analysis of all these five systems, it is known that the lower state is common to all the systems and is identified as a $^2\Sigma$ state by analogy with the ground state of some of the halides of calcium, strontium and barium.

During the course of systematic investigations on the monohalides of the group II (a) elements, the spectrum of CaBr has been investigated in emission, in a high frequency discharge (40 MHz), from a 500 watt oscillator by passing bromine and argon over heated calcium metal in a conventional quartz discharge tube. The spectrum has also been excited using an anhydrous sample of $CaBr_2$ in the presence of argon. In both these discharges, the spectrum revealed a new system of bands degraded to shorter wavelengths in the region λλ 4600-4950 Å, in addition to the previously known systems of CaBr. As the system is weak, it was photographed on a Fuess spectrograph giving exposures of 30 minutes on Ilford Special Rapid panchromatic plates.

The system is seen to consist of five groups of double-double headed bands degraded to shorter wavelengths as shown in Fig. 1. The strong central group is easily identified as the $\Delta v = 0$ sequence. The two groups of bands on the longer wavelength side are identified as $\Delta v = -1$ and -2 sequences while the two groups on the shorter wavelength side are identified as $\Delta v = +1$ and $+2$ sequences. The analysis of the system showed that the lower state is the $A^2\Pi$ state of this molecule. The observed doublet separation of about 64 cm.$^{-1}$ agrees well within the accuracy of the present measurements with the doublet separation of 63·3 cm.$^{-1}$ of the $A^2\Pi$ state determined previously. As the bands are double-double headed the system can be attributed to a $^2\Sigma - {}^2\Pi$ transition. For a $^2\Sigma - {}^2\Pi$ transition we expect the following head forming branches $^oP_{12}$, $P_2 + {}^PQ_{12}$, P_1 and $Q_1 + {}^QP_{21}$ for bands degraded towards violet. The wave number, and classification data of the band heads are given in Table I. The following vibrational quantum formula represents the inner P_2 and Q_1 heads within an accuracy of 0·5 cm.$^{-1}$ (Table I).

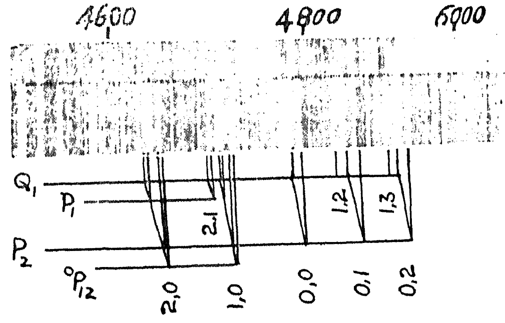


FIG 1. The New $^2\Sigma - {}^2\Pi$ system of the CaBr molecule.

TABLE I

Band head data of the new $^2\Sigma - {}^2\Pi$ system of the CaBr molecule

Wave numbers (cm.$^{-1}$)	Classification v', v''	Band head	$\nu_{obs.} - \nu_{cal.}$ (cm.$^{-1}$)
20270·1	0, 2	P_2	−0·3
20335·2	0, 2	Q_1	+0·4
20394·4	1, 3	Q_1	+0·4
20554·4	0, 1	P_2	0
20611·4	1, 2	P_2	−0·4
20619·2	0, 1	Q_1	+0·4
20676·7	1, 2	Q_1	+0·5
20840·2	0, 0	P_2	0
20895·4	1, 1	P_2	−0·4
20904·6	0, 0	Q_1	0
21175·0	1, 0	$^0P_{12}$	..
21181·6	1, 0	P_2	0
21239·2	1, 0	P_1	..
21245·9	1, 0	Q_1	−0·1
21291·2	2, 1	P_1	..
21299·3	2, 1	Q_1	−0·3
21511·2	2, 0	$^0P_{12}$	..
21520·8	2, 0	P_2	−0·2
21575·0	2, 0	P_1	..
21585·3	2 0	Q_1	−0·1

$$\nu \equiv \left.\begin{matrix} 20812\cdot3 \\ \\ 20876\cdot7 \end{matrix}\right\} + 343\cdot4\,(v' + \tfrac{1}{2}) - 1\cdot0\,(v' + \tfrac{1}{2})^2 - 287\cdot6\,(v'' + \tfrac{1}{2}) + 0\cdot9\,(v'' + \tfrac{1}{2})^2$$

The authors wish to express their thanks to the Council of Scientific and Industrial Research (New Delhi) for the financial assistance.

Dept. of Physics, B. R. K. Reddy.
Andhra University, Y. Prabhakara Reddy.
Waltair, *June* 30, 1970. P. Tiruvenganna Rao.

---

1. Olmsted, C. M., *Z. Wiss. Photogr.*, 1906, **4**, 255.
2. Walters, O. H. and Barratt, S., *Proc. Roy. Soc.*, 1928, **118**, 120.
3. Hedfeld, K., *Z. Phys.*, 1931, **68**, 610.
4. Harrington, R. E., *New Band Systems of the Diatomic Earth Halides*, Dissertation, University of California, 1942.
5. Reddy, Y. P. and Rao, P. T., *Ind. J. Pure App. Phys.*, 1968, **6**, 181.

STUDIES ON PONGAMOL COMPLEXES OF GADOLINIUM, HOLMIUM AND ERBIUM

Several β-diketone complexes of rare earths have been reported.[1-3] In previous communications pongamol complexes of Nd, Sm, Eu and Dy were reported. This communication details the preparation and a study of spectral properties of Gd, Ho, and Er pongamol complexes.

The complexes of Gd, Ho, and Er with pongamol were prepared by the method described by Rao and co-workers.[3-6] The metal to ligand ratio was found to be 1 : 3 both by elemental analysis and also by igniting a known weight of the complex in a platinum crucible and weighing the residual oxide. [Found C : 62·2, H. 3·9 Gd $(C_{18}H_{13}O_4)_3$ requires C = 62·56, H = 3·76% ; Found C = 61·9, H 3·91, Ho $(C_{18}H_{13}O_4)_3$; C = 62·15, H = 3·74% ; Found C = 61·2, H 3·82, Er $(C_{18}H_{13}O_4)_3$ requires C 61·95, H 3·72%.]

The absorption spectra of the ligand and the chelates in the ultraviolet region were recorded using Hilger-Watts spectrophotometer and in the infrared region using a Perkin Elmer Model 137 infracord. The solids were examined as nujol mulls.

In the ultraviolet region the ligand exhibits in ethanol two absorption maxima one at 350 mμ and the other at 240 mμ. In the chelates investigated the two band maxima are located without any shift; only a large intensification is noticed in Gd and Er chelates. The $\lambda_{\text{max.}}$ and log $\epsilon_{\text{max.}}$ values are shown in Table I.

In the infrared spectra of the diketone now investigated two bands are located at 1600 and 1500 cm.$^{-1}$ These can be assigned to the enol-chelate and perturbed carbonyl. Lecomte[7] and Morgan[8] studied the infrared spectra of metal diketonates and observed a strong band between 1562 and 1550 cm.$^{-1}$, and attributed this to the C $\neq$ O stretching frequency weakened by resonance between C–O–M and C=O....M. The second band at 1515 cm.$^{-1}$ was attributed to the C=C stretching frequency. Through a study of normal co-ordinate analysis of copper acetylacetonates Nakamoto[9,10] reported that the assignments made by Lecomte were empirical. The vibrational frequencies of acetylacetonates of other metals were calculated by perturbation method.[11] It was concluded that the highest frequency found in the carbonyl region was a C=C stretching and not a C=O stretching.

Table I

Absorption bands of rare earth pongamol chelates

Substance		Ethanol	
		λmax.	log εmax.
Pongamol	..	350	4·344
$C_{18}H_{14}O_4$	..	240	4·358
Gd $(C_{18}H_{13}O_4)_3$	..	350	5·031
		240	5·145
Ho $(C_{18}H_{13}O_4)_3$	..	350	4·38
		240	4·60
Er $(C_{18}H_{13}O_4)_3$	..	350	4·687
		240	4·687

Thus the 1600 cm.$^{-1}$ band of the ligand is due to the C = C stretching and the 1550 cm.$^{-1}$ might be due to the C=O stretching.

In the complex now investigated two strong bands are located at 1545 and 1525 cm.$^{-1}$ and these may be attributed to the C = C and C $\neq$ O stretching respectively.

The authors are grateful to Prof. N. V. Subba Rao, Osmania University, Hyderabad, for the facility to record the spectra.

Dept. of Chemistry, D. Purushotham.
Marathwada University, V. Ramachandra Rao.
Aurangabad, *March* 9, 1970.

---

1. Sacconi, L. and Ercoli, R., *Gaz. Chem. Ital.*, 1949, p. 731.
2. Moeller, T. and Ulrich, W. F., *J. Inorg. and Nucl. Chem.*, 1956, **2**, 164.
3. Purushotham, D., Ramachandra Rao, V. and Raghavarao, Bh. S. V., *Anal. Chim. Acta*, 1965, **33**, 185.
4. Ramachandra Rao, V. and Murty, P. R., *Curr. Sci.*, 1969, **5**, 38.
5. Murty, P. R. and Rao, V. R., *Indian J. Chem.*, 1965, **3**, 321.
6. —, and —, *Curr. Sci.*, 1966, **5**, 12.
7. Lecomte, J., *Di. Sc. Faraday Soc.*, 1953, **9**, 125.
8. Morgan, G. T., *U.S. Commission AECD*, 1949, **16**, 12659.
9. Nakamoto, K., *IR Spectra of Inorganic and Coordination Compounds* (John Wiley & Sons, N.Y., 1963, p. 216.
10. — and Martell, A. E., *J. Chem. Phy.*, 1960, **32**, 588.
11. —, Mac Carthy, P. N., Ruby, A. and Martell, A. E., *J. Am. Chem. Soc.*, 1961, **83**, 1272.

DEMONSTRATION OF GOLGI APPARATUS IN TISSUE CULTURE CELLS

ABSTRACT

A simplified procedure for demonstrating Golgi apparatus in tissue culture (TC) cells has been adapted from the method of Elftman. The TC coverglass preparations are quickly rinsed in 1% cadmium nitrate, fixed 1½ hr. in formalin 15 ml., silver nitrate 2 g., cadmium nitrate 1 g., glass distilled water to make 100 ml. solution; and are developed for 1½ hr. in 2% hydroquinone in 100 ml. of 15% formalin. Then the TC coverglasses are washed, gold toned, counterstained with hematoxylin and acid orange G, dehydrated, cleared and mounted.

GOLGI apparatus is no longer regarded as purely an artefact. It has been demonstrated in almost all nucleated animal as well as plant cells. Its morphological changes serve as an index of physiological activity of the cell. Several techniques for demonstrating Golgi apparatus have been described for tissues. The Elftman's[1] direct formalin-silver nitrate solution—simultaneous fixation and impregnation method—is the most dependable one. The network like Golgi apparatus demonstrated by this method seems to have the histochemical basis of silver reduction by aldehyde dehydrogenase in the presence of aldehyde (Chu and Swinyard[2]). The available literature on tissue culture (TC) cytological procedures does not include a simplified technique for demonstrating Golgi apparatus in tissue culture cells spread on tissue culture coverglass (TCC). The technique presented here has been developed by adapting the Elftman's procedure and has been successful with different TC cell lines.

PREPARATION OF SOLUTIONS

(*i*) 1% cadmium nitrate solution in double glass distilled water.

(*ii*) Fixative (modified after Elftman[1]): dissolve 2 g. silver nitrate (double crystals, Johnson) and 1 g. cadmium nitrate (E. Merck) in 100 ml. of 15% commercial formalin solution prepared in double glass distilled water. Prepare just before use.

(*iii*) Developer: dissolve 2 g. Hydroquinone crystals, in 100 ml. of 15% commercial formalin prepared in double glass distilled water.

(*iv*) 0·1% Gold chloride (Johnson and Matthew) solution in double glass distilled water.

(*v*) 5% aq. solution of hypo.

(*vi*) Delafield's Hematoxylin.

(*vii*) Acid Orange G. (Pearse[3]). Dissolve 2 g. Orange G. (Grübler or Chroma) in 100 ml. of 5% aq. phosphotungistic acid. Stand for 24 hr. and use after filtering.

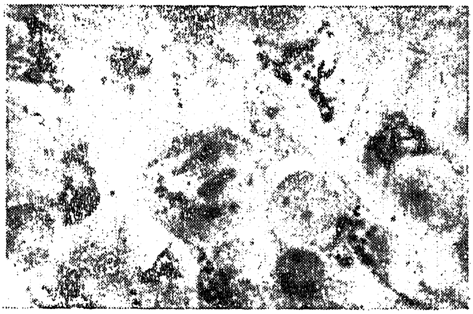


FIG. 1. Sarcoma cells cultivated *in vitro* showing network of Golgi apparatus. Note dark Vesiculate Golgi material in the Central dividing cell in anaphase. Modified Elftman's procedure, × 600 (approx.)

PROCEDURE

1. Rinse coverglass tissue culture preparations quickly but thoroughly in solution (i).
2. Transfer the TCC immediately to the fixative (solution ii) for 1½ hr. at 22° C. in total darkness. Contacts with metals, corks, rubber, etc., must be totally avoided (*see* Deck and De Souza[4]).
3. Rinse quickly in 1% cadmium nitrate solution at 22° C. and transfer immediately to the developer (solution iii) for 1½ hr. Keep in darkness at 22° C. temperature.
4. If too much silver deposit covers the cells, gently wipe the cell surface with cotton-wool moistened with water to remove superficial deposition.
5. Wash in running water and rinse in distilled water.
6. Gold tone the silver impregnated Golgi apparatus by placing TCC in Gold Chloride (solution iv) for 15 minutes, rinse quickly in distilled water and treat with 5% hypo (solution v) for another 15 minutes. Then wash thoroughly in running water. Rinse in distilled water.
7. Stain nuclei in hematoxylin (solution vi) for 10 minutes. Blue the nuclei in running water.

8. Dehydrate gradually through grades of 25%, 50%, 70%, and 80% alcohol allowing ½ hr. in each grade. Store and harden cells overnight in 85% alcohol.
9. Hydrate through 70%, 50%, 25% alcohol, keeping 5 minutes in each grade only. Bring the TCC to distilled water.
10. Counterstain with orange G (solution vii) briefly for 30 to 60 sec.
11. Wash quickly but thoroughly in distilled water.
12. Dehydrate and clear by one step alcoholic-clove oil method (Shah[5]) and transfer to pure xylene, three changes. Alternatively, pass TCC rapidly through 70%, 100% (thrice), Xylol-alcohol mixture 50 : 50 and finally in pure Xylene (thrice).
13. Mount in canada balsam or in De Pex (Gurr).

    Results.—Golgi apparatus : blue-black network or vesicles, nuclei : deep orange-red, background : yellow.

I am grateful to Dr. Kamal J. Ranadive for her interest in this work. The fellowship award by the Indian Cancer Society, Tata Memorial Hospital, Parel, Bombay-12, is thankfully acknowledged.

Research Division, NAVANIT L. SHAH.
Biotech. Laboratories,
759/89, Poona-4 (India),
June 24, 1970.

---

1. Elftman, H., *Stain Technol.* 1952, **27**, 47.
2. Chu, C. H. U. and Swinyard C. A., *J. Bioph. Biochem. Cytology*, 1956, **2**, 263.
3. Pearse. A. G. E., *Histochemistry Theorotical and Applied*, 2nd ed., J & A Churchill, London, 1969, p 831.
4. Deck, J. D. and De Souza, G., *Stain Technol*, 1959, **34**, 287.
5. Shah. N. L., *Proc. Ind. Sc. Congress. Assc.*, Baroda, Late Abstracts 1955, Part IV, Art. 123.

IN VITRO CULTURE OF EMBRYONIC CELLS FROM AN INDIAN TRIATOMINE BUG, *TRIATOMA RUBROFASCIATUS* DE GEER (HEMIPTERA : REDUVIIDAE)

ATTEMPTS to culture the cells of various triatomine bugs *in vitro* have met with limited success.[1-3] Recently, Verma and Pudney[4] were successful in maintaining the embryonic cells of *Triatoma maculata in vitro* in a healthy condition upto 40 days. This communication reports the attempts made to culture the embryonic cells of another triatomine bug, *Triatoma rubrofasciatus.*

The techniques and the culture medium used in the present study were similar to those described by Singh and Bhat[5] for *Anopheles stephensi* cell cultures. About one hundred eggs with almost fully formed embryos were obtained from the laboratory colony of bugs, and were used to set up a culture.

Within twenty-four hours a few isolated cells and some tissue pieces were observed attached to the glass surface, whereas the rest of the tissues remained floating in the medium. On the second day the cells started migrating from the attached tissues. This process continued for about ten days. A large number of small, multicellular hollow vesicles similar to those of *Aedes œgypti* cultures[6,7] were also observed developing from attached as well as floating tissues (Figs. 1, 2).

Three different types of cells growing on the glass surface were observed in these cultures.

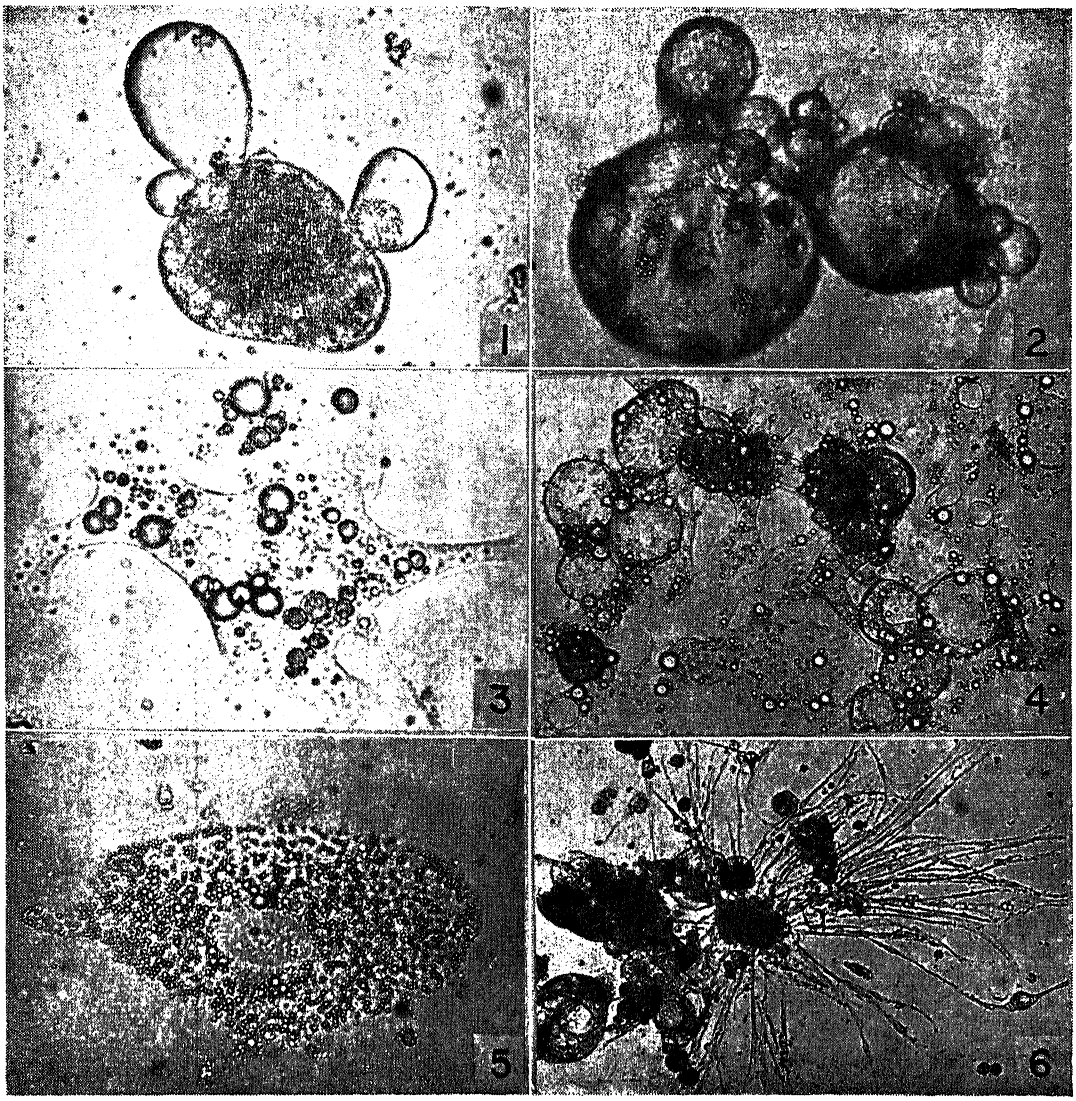
Type I.—The cells were mono- or multinucleated, irregular in shape with thin cytoplasm having a few small vacuoles in the early phase of growth (Fig. 3). These cells grew in size by spreading of cytoplasm accompanied by an increase in the number and size of the vacuoles (Fig. 4). They were usually found in patches of 10 to 25 cells each.

Type II.—The cells were mono- or binucleated occurring singly or in small groups of two or three. They had well-defined cell boundary with compact cytoplasm. The cytoplasm was highly granular with a few small vacuoles (Fig. 5).

Type III.—The cells were long and narrow, appearing like muscle fibres. They always grew out from attached pieces of tissues (Fig. 6), and showed rhythmic pulsation upto 15 days. Their morphology and pulsating activity were similar to that of the muscle cells of *Anopheles stephensi* cell cultures.[5]

The cultures were maintained in a healthy condition for about 30 days by feeding them with fresh growth medium once in six or seven days. After this period the attached cells started coming off from the glass surface and disintegrated.

Mitosis was not observed in these cells and the attempts to subculture them were not successful.



FIGS 1-6. Hollow vesicles and cell types of *Triatoma rubrofasciata* in primary culture [illegible]. Fig. 1. Hollow vesicles in their early stage of growth, 3-day-old culture, × 200. Fig. 2. Multicellular hollow vesicles in 10-day-old culture, × 100. Fig. 3. Type I cell in 3-day old culture, × 400. Fig. 4. Type I cells in 10-day-old culture, × 100. Fig. 5. Type II cell in 10-day-old culture, × 200. Fig. 6. Type III cells in 10-day-old culture, × [illegible].

Virus Research Centre, U. K. M. BHAT.
Poona, India, *May* 30, 1970. K. R. P. SINGH.

---

1. Luscher, M., *Nature*, 1947, **160**, 873.
2. Goodchild, A. J. P., *Ibid.*, 1954, **173**, 504.
3. Vago, C. and Flandre, *Ann. Epiphyt.*, 1963, **14**, 172.
4. Varma, M. G. R. and Pudney, M., *Exptl. Cell. Res.*, 1967, **45**, 671.
5. Singh, K. R. P. and Bhat, U. K. M., *Ind. J. Med. Res.*, 1969, **57**, 52.
6. —, *Curr. Sci.*, 1967, **36**, 506.
7. Bhat, U. K. M. and Singh, K. R. P., *J. Med. Ent.*, 1969, **6**, 71.

DEGENERATION OF THE INSEMINATED SPERMATOZOA AFTER OVULATION IN TWO SPECIES OF INDIAN BATS

GOPALAKRISHNA AND MADHAVAN (in press) recorded the protracted survival of the inseminated spermatozoa for nearly five weeks in the female genital tract of the tropical Indian vespertilionid bat, *Pipistrellus ceylonicus*. They noted that this species has a sharply defined breeding season, copulation taking place during the first two weeks of June. The inseminated sperms remain alive inside the female genital tract until about the second week of July, when ovulation and fertilization take place followed immediately by pregnancy.

Swarms of spermatozoa are present in the uterus and the Fallopian tubes in this species up to the time when the embryo develops into a morula, that is, for about four to five days after fertilization, after which the sperms degenerate within a short time. It is significant that the sperms, which could remain alive for nearly five weeks before ovulation, degenerate within a short time after ovulation. Evidently, the medium in which the sperms lie must have become changed after ovulation, and this should be responsible for the quick degeneration of the spermatozoa. Soon after ovulation the most noteworthy change in the female genital organs in this species relates to the rapid development in each ovary of a corpus luteum, which reaches its full development by the time the ovum develops into a morula. During this period the uterus shows pronounced progestational changes, thereby indicating that the corpus luteum is actively secreting progesterone. Evidently, the degeneration of the stored sperms is, in some way, related to the production of progesterone in the ovary. It is, therefore, contended that as the corpus luteum becomes progressively developed, and the progesterone level in the blood increases, it induces changes, either directly or indirectly, on the composition of the secretions from the uterine glands and the Fallopian tubes so that the sperms are no longer able to survive in the new medium.

In the Indian fruit bat, *Pteropus giganteus*, only one side of the female genitalia is functional during each pregnancy cycle and only one ovary undergoes ovulation, and a single corpus luteum is formed in the functional ovary. In this species it was noticed that, whereas all the spermatozoa degenerated in the prospective pregnant uterine cornu soon after the corpus luteum is developed, the sperms remained unaffected in the non-pregnant uterine cornu at least until the embryo reaches the neural groove stage of development. In *Pteropus giganteus* the progestational changes occur only in the uterine cornu of the side in which ovulation occurs. This is because there is a unique mechanism of progesterone transport in this animal. A direct portal circulation is established between the corpus luteum and the corresponding uterine cornu so that the progesterone produced by the corpus luteum is short-circuited, and is directly transported to the corresponding uterine cornu (Marshall, 1953). This would explain why the sperms in the prospective pregnant uterine cornu undergo degeneration within a short time after ovulation. On the other hand, the sperms survive in the opposite uterine cornu for a longer period since the non-pregnant cornu does not seem to be affected by the activity of the corpus luteum. This is an added evidence in support of the contention that the degeneration of the sperms in the genital tract of the female bats after ovulation is, in some way, related to the activity of the corpus luteum. One pertinent fact worth mentioning here is that in the hibernating bats of the cold countries, where the spermatozoa have been known to survive for several months, ovulation does not occur, and therefore, the corpus luteum is not formed during the hibernating period (Matthews, 1937; Wimsatt, 1942) when the sperms survive in the female genital tract.

Department of Zoology, A. Gopalakrishna.
Institute of Science, R. B. Phansalkar.
Nagpur, *May* 28, 1970. J. D. Sahasrabudhe.

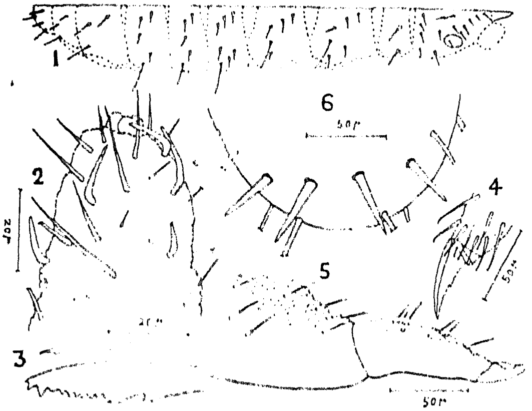
---

1. Gopalakrishna A. and Madhavan, A., *Proc. Ind. Acad. Sci.* (In press).
2. Marshall. A. J., *J. Endocrinol.*, 1953, **9**, 42.
3. Matthews. L. H., *Trans. Zool. Soc. Lond.*, 1937, **23**, 224.
4. Wimsatt, W. A., *Anat. Rec.*, 1942, **83**, 299.

OUDEMANSIA SUBCOERULEA DENIS.—THE FIRST RECORD OF A MARINE COLLEMBOLA (INSECTA) FROM INDIA

INSECTS are generally terrestrial. Aquatic forms are known but most of these are inhabitants of the freshwater bodies. In this communication, a marine collembolan is recorded from India. The following brief description is helpful in recognizing this insect and is based on 13 specimens collected in October 1965 from small pools of sea-water on rocks left by waves at Kanyakumari (Cape Comorin).

Length up to 1·9 mm. Body deep bluish-black dorsally with small irregular lightly pigmented areas; ventra side paler. Cuticle coarsely granulate. Clothing of plain setæ. On th.II-III p_3 is *ss* (sensory seta), on abd. I-IV p_4 is *ss*, on *abd.* V p_3 is *ss* and on *abd.* VI a_1 and a_2 are anal spines. Antennæ subequal to head; antennal ratio as 15 : 15 : 13 : 10. Ant. IV apically with a trilobed papilla, 3 stout bent sense rods on the distal half and two subequal sense rods on the proximal half. Ant. III with two short sense rods and a longer guard sense rod but without cuticular pockets or folds. Buccal cone well developed, projecting beyond the anterior margin of the head and visible from the dorsal side. Mandibular head fairly broad with about a dozen teeth arranged in a row on the inner aspect. Maxilla head composed of a single needle. Postantennal organ absent. Ocelli 8 + 8 subequal. Claw with a prominent inner tooth at about the middle. Unguiculus absent. Clavate tenent hair absent but distal end of the hind tibiotarsus with six prominent setæ having curved tips. Tenaculum with 3 + 3 dents on rami and without a seta on the corpus. Furcula well developed; segments related as 6 : 5 : 2. Dorsal and dorsolateral region of manubrium and dens with coarse turbercles. Dorsally manubrium with 14 setæ and dens with 6 setæ. Mucro plump and triangular with equal inner and outer margins and a curved tip.



FIGS. 1–6. *Oudemansia subcoerulea* Denis. Fig. 1. Dorsal chætotaxy of the right half-diagrammatic. Fig. 2. Ant. III-IV showing sensillæ. Fig. 3. Head of maxilla and mandible. Fig. 4. Hind foot. Fig. 5. Lateral view of furcula. Fig. 6. Dorsal view of abd. VI showing the anal spines.

Oudemansia subcoerulea was first described by Denis[1] from Indo-China and has not been recorded from elsewhere. This species is closely related to *O. coerulea* Schoot[2] but differs from the latter in the presence of a prominent median tooth on the claw and the smaller and unequal nature of the anal spines. Chætotaxy of the body and furcula, sense-organs of ant. III and ant. IV and structure of the mouth parts are additional details given here.

The author is grateful to Prof. K. K. Nayar for guidance and to the Kerala University for financial assistance.

Dept. of Zoology, N. R. PRABHOO.
University of Kerala,
P.O.: Karyavattom, Trivandrum,
India, *July* 6, 1970.

---

1. Denis, J. R., *Mus. Heude. Notes Ent. Chin.*, 1948, **12** (17), 183.
2. Schott, H., *Ent. Tidskr.*, 1893, p. 171.

NODULATION OF SOYBEAN IN COIMBATORE SOIL

IT has been frequently observed that the red clayey soil of Coimbatore (pH 8·3) which cracks heavily in the absence of moisture is not conducive for nodulation of legumes in general and soybean in particular in spite of inoculation with *Rhizobium*. Earlier studies[1-7] have revealed three major ways to overcome the inability of legumes to nodulate: (*i*) assessment of the microbial status of the soil in relation to rhizobia, (*ii*) amelioration of the deficiencies in the physical characteristics of the soil so as to render it favourable to legume-*Rhizobium* interactions, and (*iii*) regulation of soil moisture.

Coimbatore soil was transferred to Delhi and work on the lines outlined above revealed the following facts: (1) none of the bacteria, fungi and actinomycetes in the soil proved inhibitory to rhizobia, although *Cephalosporium* spp. antagonistic to rhizobia[6] have been encountered in the rhizosphere of soybean (Siddiqui—personal communication), (2) pelleting the seeds with lime and peat culture of *Rhizobium japonicum*[8] (S.B. 16) proved beneficial to nodulation, especially when the moisture in the soil was conserved by mulching with wheat straw or covering the top of the soil with sand (Table I and Fig. 1). The dry weight of the plants in the wheat straw-mulched treatment was superior to others. These results reflect that pelleting of seeds coupled with mulching

TABLE I

Nodulation and yield in Coimbatore soil using soybean (var. Bragg) and R. japonicum, *SB* 16

(Mean of three replicate pots each having four plants). The soil was amended as follows (kg./ha.): P_2O_5—100; $ZnSO_4$—1·0; $MnSO_4$—1·0; Borax—1·0 and ammonium molybdate—0·5.

Sl. No.	Treatment		No. of nodules	Dry wt. (g /plant)
1.	Control (uninoculated)	..	0	0·5
2.	Inoculated and lime-pelleted	..	3	0·5
3.	2 + soil with quartz sand on top	..	53	0·9
4.	2 + soil with wheat straw on top	..	63	**2·3**

of soil with straw may ameliorate the soil conditions unfavourable to nodulation in Coimbatore soil. Experiments on a micro-plot scale with soybean conducted at the Regional Research Station, I.A.R.I., Coimbatore, indicated similar beneficial effects.

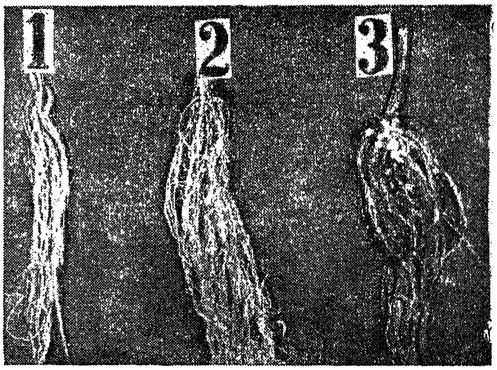


FIG. 1. Effect of pelleting and mulching on nodulation response of soybean. 1. Inoculated and lime-pelleted. 2. Inoculated and lime-pelleted + top layer of quartz. 3. Inoculated and lime-pelleted + wheat straw-mulched.

Thanks are due to Dr. R. Krishnaswami, Soybean Breeder, I.A.R.I., Regional Station, Coimbatore, for supplying the soil sample and for conducting the field experiment.

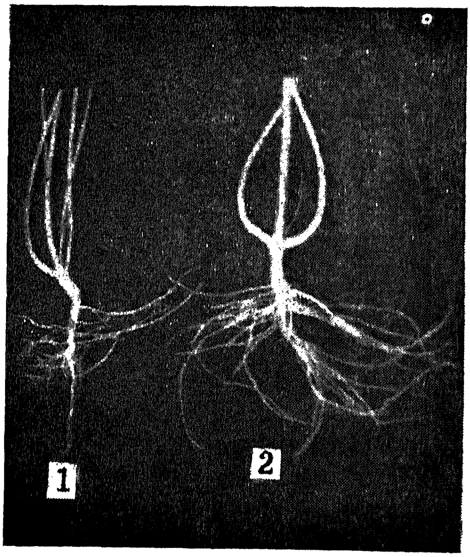
Division of Microbiol., V. ISWARAN.
Indian Agricultural W. V. B. SUNDARA RAO.
Research Institute, N. S. SUBBA RAO.
New Delhi-12, V. R. BALASUNDARAM.
June 24, 1970. R. G. APTE.

---

1. Collis-George, N. and Davey, B G., *Soils and Fertilizers*, 1960. **23**, 307.
2. Daitloff, A., *Qd. J. Agric. Anim. Sci.*, 1967, **24**, 315.
3. Dommergass, Y., *Mem. Inst. Sci., Madagaskar*, 1953, **5**, 229.
4. McCalla, T. M. and Army, T. J., *Advan. Agron.*, 1961, **13**. 125.
5. — and Duley, F. L., *Science*, 1948, **108**, **163**.
6. Sudba Rao N. S. and Vasantha, P., *Naturwissenchaften*. 1965, **52**, 65.
7. Sethi. R. P. and Subba Rao, N. S., *J. Gen. Appl. Microbiol.*, 1968. **14**, 325.
8. Hastings, A., *New Zealand Fmr.*, 1962, **83**, 20.

MUTATIONAL EVIDENCE FOR THE ORIGIN OF INDO-GANGETIC AND PENINSULAR TYPES OF INDIAN LINSEED

THE Indian linseeds have been broadly classified into two types, Peninsular and Indo-Gangetic or alluvial of which the former is grown to the south of the Ganges and Jumna and the latter to the north of these rivers. The Peninsular type with bolder seeds, rich in oil content, is quick growing and early maturing but is a poor yielder in contrast to the alluvial type which has smaller seeds with less oil and is slow growing, later in maturity but is a good yielder. The essential difference between them lies in their root system, the Peninsular types possessing tap-roots which penetrate deeply developing laterals at greater depths in contrast to the Indo-Gangetic types which possess tap-roots which do not penetrate deeply and which have numerous secondary roots near the soil surface.[1] Gamma radiation has changed the Peninsular type to Indo-Gangetic providing evidence for the mutational origin of these types of Indian linseed. The practical implication of this finding is, that as these two types can mutate back and forth, there is no need to breed varieties exclusively in the north and south: they can be bred either in the north or the south.



FIGS. 1-2. Fig 1. Normal deep tap-root and a few lateral roots. Fig. 2. Mutated arrested tap-root with numerous lateral roots.

From two cultivated varieties of linseed, NPRR 9 and EB 3, possessing Peninsular traits, being derived by hybridization from Peninsular types, exposed to 40, 60 and 80 kilo rads of gamma-rays, several mutations with the phenotypic characters of the alluvial types with reduced tap-roots and numerous secondary roots near the soil surface were recovered (Figs. 1 and 2). This change in the root system was also accompanied by a change in the constellation of characters characteristic of the Indo-Gangetic types. As a corollary to this finding it can be expected that a mutation involving a deep tap-root system, from a shallow one, may also arise. Thus, the two Indian linseed types might have had a mutational origin. Such mutations of phylogenetic interest, where single gene mutations leading to subspecific and racial differentiation, have been reported in crops like wheat[2-4] and rice.[5]

It is said[3] that these two types have arisen as a result of interspecific hybridization of linseed, *Linum usitatissimum*, which is supposed to have been originally introduced into India from Egypt, with *L. strictum* in the north and *L. perenne* and *L. mysorense* in the south and thus have different lines of origin. As interspecific hybridization has not produced any economically useful types it is unlikely that they arose by this method and more so from *L. mysorense* which has twice the number of chromosomes ($2n = 60$) as *L. usitatissimum* and with which it has not been so far crossed.

Thanks of the senior author are due to the Indian Council of Agricultural Research, New Delhi, for providing him a Research Fellowship during the course of this work.

Division of Genetics, A. SEETHARAM.
I.A.R.I., New Delhi-12, D. SRINIVASACHAR.
July 6, 1970.

---

1. Howard, G. L. C. and Khan, A. R., *Mem. Dep. Agric. India*, 1924, **12**, 135.
2. Mac Key, J., *Hereditas*, Lund., 1954, **40**, 65.
3. Richharia, R. H., *Linseed*, Published by the Central Oilseeds Committee, Examiner Press, Bombay, 1962, p. 153.
4. Sears, E. R., *Handbuch Pflanzenzucht*, 1959, **2** 164.
5. Swaminathan, M. S., Siddique, E. A., Sarin, V. N. and Veughese, G., *Proceedings of a Panel I.A.E.A. and F.O.A.*, Vienna, 1967, p. 233.

FUNGAL ACTIVITY IN THE SOIL BELOW THE ROOT-TIP REGION

PROXIMITY to plant root is known to reverse soil fungistasis.[1] Though the effect of root exudates on fungi has been extensively studied,[2] little is known of the extent to which these exudates affect the fungal propagules found in the soil below the root. Contrary to the belief that root-tip region is devoid of fungal activity,[3] it has been demonstrated by Sivasithamparam and Sulochana[4] that this region of the root does have fungal activity in the form of actively growing mycelia. A preliminary investigation was undertaken to study the effect of root on fungal spores below the root-tip region of pea (*Pisum sativum* L.).

A spore suspension of a *Fusarium* sp. (isolated from the rhizosphere of a pea seedling) was mixed with 500 g. lots of unsterilized garden soil contained in clay pots. Pea plants were raised, one in each of four replicate pots. Four replicate unsown pots of soil served as 'control'. Soil *ca.* 5 cm. below the root-tip was sampled six days after germination. Care was taken to see that the bottom end of the soil core was always held tilted up during sampling. Soil from 'control' pots was sampled at a similar depth. Germination of the *Fusarium* spores was studied using Papavizas's[5] technique.

It was found that at 5 cm. below the root-tip region 32% of the observed spores had germinated, while only 2·6% of the spores examined from the 'control' soil showed germination.

As it may not be possible for root-exudates to reach soil far below the root-tip without being metabolized by bacteria inhabiting the intervening soil, a likely explanation is provided by recent work on the effect of volatiles on soil fungi. According to Prof. Ralph Baker (pers. comm., 1970) "it is possible, especially in light soils, for volatiles to be influential to greater distances than compounds ordinarily considered to be exuded by roots".

As volatiles have been implicated in soil fungistasis,[6] investigations are clearly necessary into the part played by such volatiles in the initiation of the 'rhizosphere effect', below the root-tip region.

I am deeply indebted to Prof. T. S. Sadasivan, Prof. C. V. Subramanian and Dr. C. B. Sulochana for initiating me into this field of study.

Agri. Res. Station, K. SIVASITHAMPARAM.
Sita Eliya, Nuwara Eliya,
Ceylon, *May* 26, 1970.

---

1. Jackson, R. M., *Nature*, 1951, **180**, 96.
2. Rovira, A. D., In *Ecology of Soil-borne Plant Pathogens*, University of California Press, Berkeley & Los Angeles, 1965, p 170.
3. Parkinson, D., In *Soil Biology*, Ed., A. Burges and F. Raw, Academic Press, London & New York, **1967**, p. **449**.
4. Sivasithamparam, K. and Sulochana, C. B., *Pl. Soil*, 1969, **30**, 34.
5. Papavizas, G. C., *Phytopathology*, 1967, **57**, 1243.
6. Menzies, J. D. and Gilbert, R. G., *Soil Sci. Soc. Amer. Proc.*, 1967, **31**, 495.

A NEW MUTANT INDUCED IN BARLEY

SEVERAL investigators[1-3] in the past have reported a number of viable mutants in barley, induced by diverse mutagens, which affected growth habit, maturity and ear characteristics. During our work on induced mutagenesis in *Hordeum vulgare* L. ($2n = 14$) var. N.P. 113, planned with a view to study the effect of different physical and chemical mutagens on polygenic characters, a new recessive mutant affecting the shape of the grains in the six-rowed ears, was isolated in a single M_2 progeny of 0·3% ethyl methanesulphonate treated seeds (Table I). In the present communication, some of the important aspects of this interesting mutant are summarized.

TABLE I

Mutation frequency for notched character

Treatment	No. of M_1 families	No. of M_2 plants	Mutation frequency: % M_1 families segregating	Mutation frequency: % M_2 plants mutated
Control ..	82	8191	0	0
EMS 0·3% ..	82	6425	1·2	0·03

The mutant has been designated as "Notch mutant" primarily because of a unique and uniform depression on the dorsal side of its grains. This grain character seems to be associated with chlorophyll deficiency, the expression of which starts from the second leaf. The first leaf was green but the second and subsequent leaves were pale yellow to start with and finally turned to *striata* with green streaks. The mutant was normally fertile with viable seeds and there was no discernible difference in the shape and size of spikes between the normal and the notched plants which have been studied up to M_5 generation. However, the flowering in the mutant was delayed by 8 to 10 days. Grain development in the mutant was normal up to the milk stage after which the "notch" character started expressing and became more prominent when the seeds were ripe. Due to the depression the grains were thinner and lighter in weight than the control (1,000 grain weight reduced by 30% in the mutant).

Notched grains were very difficult to grind and the paste became very sticky. Even after high speed centrifugation the supernatant was highly viscous in comparison to the control. Chemical analysis of the seeds revealed (1) significant difference in the contents of reducing and total sugars in the mutant and the control (Table II), (2) reduction in carbohydrate to 50% of control, and (3) 80% increase in the total protein content over control without any addition or deletion of a protein band.

TABLE II

The contents of reducing and total sugars

Phenotype	Reducing sugars (mg./100 gm. fresh weight)	Total sugars (mg./100 gm. fresh weight)
Control ..	247·8	1260·0
Mutant ..	108·5	1000·0

Cytological examination of the mutant showed that it was not associated with any gross morphological change in its chromosomes. Linkage relations of this recessive and true breeding mutant are being studied using trisomics and tester stocks. The mutant can be of value in studies of genetic analysis in barley since it serves as a marker and can be identified in the seedling as well as in adult stages. The earlier expression of the phenotype in seedling characters also permits a considerable saving of time.

The author is grateful to Dr. M. S. Swaminathan, Director, for his guidance. Thanks are also due to Drs. C. R. Bhatia and M. D. Upadhya for their help in chemical analysis.

Division of Genetics, H. C. BANSAL.
Indian Agricultural
Research Institute,
Delhi 12. *June* 15, 1970.

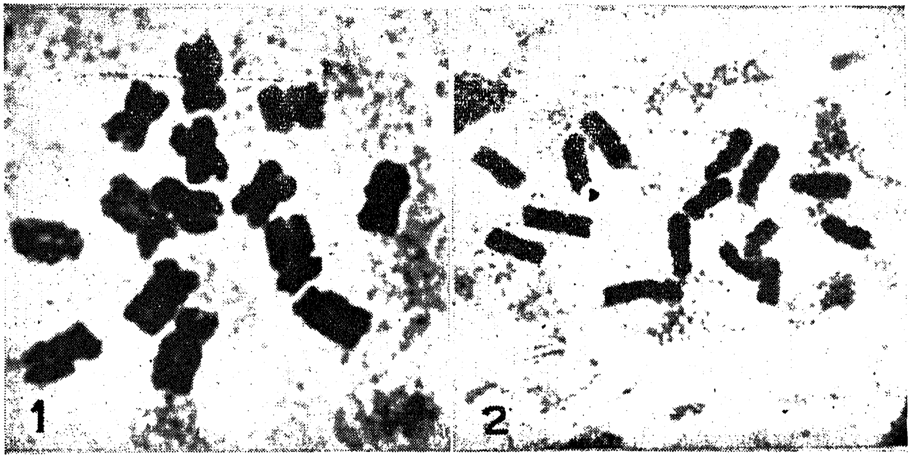
---

1. Ehrenberg, L., Gustafsson, A. and Lundqvist, U., *Hereditas*, **1961**, **47**, 243.
2. Gustafsson, A., *Ibid.*, **1963**, **50**, 211.
3. Ramanna, M. S. and Natarajan, A. T., *Ind. J. Genet.* **1965**, **25**, 24.

A TECHNIQUE OF SQUASHING STIPULE TIPS OF PEA

SQUASH preparations for chromosome study have been made from different tissues. De Lautour (1960) described a technique of squashing leaf buds of grass shoots. This method was modified by Bennet (1964). In dicotyledons, meristematic leaf tissue was squashed for mitotic study by Baldwin (1939) and Sharma and Sharma (1957). Das and Goswami (1968) used leaf-sheath meristem of barley for comparing mitosis with meiosis in translocation heterozygotes. This note describes a technique of squashing stipule tip meristem of pea for the study of somatic chromosomes of normal and trisomics.

Tips of young emerging stipules were collected in 0·002 mm. solution of 8-hydroxyquinolin in small vials and after 4 hours, the material was fixed in 3 : 1 ethanol-acetic acid mixture at 18° C. for 20 hours and finally stored in 70% alcohol in a refrigerator.



FIGS. 1–2. Pea stipule tip mitosis at metaphase from a normal (Fig. 1) and a trisomic (Fig. 2) plant.

A stipule tip was cut into small pieces and hydrolyzed in 1 part N HCl and 9 parts of 1·5% aceto-carmine in a vial and heated at 60° C. for 2 minutes. A small piece was then put in a drop of 1% aceto-carmine on a slide and cut into very small pieces by a sharp blade, squashed and sealed with paraffin wax. Transferring the material to 1% aceto-carmine for half-an-hour before squashing gave better contrast between the chromosomes and cytoplasm. Excess stain was removed by adding a drop of 45% acetic acid followed by slight warming. For satisfactory results, the processes of hydrolysis, warming, tapping and pressing of cover glass have to be done gently.

Slides were made permanent by passing through :

(a) 1 part tertiary butyl alcohol : 1 part acetic acid (2 minutes), and
(b) Pure tertiary butyl alcohol (2 minutes).

Slides were washed in pure xylol and mounted in euparol.

Mitotic chromosomes of normal and trisomics were studied. Metaphase plates of normal and trisomics are shown in Figs. 1 and 2 respectively. Stipule tip mitosis provides an opportunity to compare the somatic and meiotic chromosomes of the same plant. Stipule tip study has not yet been reported in pea. Possibility of effecting further improvement through pretreatment and modification of the staining schedule is under investigation.

Dept. of Genetics and Plant Breeding, K. DAS.
Banaras Hindu University, KALLOO.
Varanasi-5, *June* 10, 1970.

---

1. Baldwin, J. T., *Science*, **90**, 240.
2. Bennet, E., *Euphytica*, 1964, **13**, 44.
3. Das, K. and Goswami, B. C., *Nucleus*, 1968, **11**, 53.
4. Lautour, G. De, *New Zealand Jour. Sci.*, 1960, **3**, 327.
5. Sharma, A. K. and Sharma, A., *Stain Tech.*, **32**, 167.

NEW HOSTS OF *CORYNESPORA CASSIICOLA* (BERK. AND CURT.) WEI

Corynespora cassiicola (Berk. and Curt.) Wei[1-4] on brinjal and tomato has been occurring in Tirupati since 1965 during September-February period. During our studies on *Corynespora* leaf spot of brinjal, we noticed it on chilli, *Solanum nigrum* L., *Ocimum sanctum* L., *Leucas aspera* Spr., *Croton sparsiflorus* Mor,[1,2] *Gossypium hirsutum* L.,[3] *Digera arvensis* Forsk. and *Syzygium jambolanum* D.C. A comparative study of the disease in the above hosts is reported here.

Leaf spots on tomato and chilli are dark brown, 3–4 mm. in diameter and target type with a chlorotic halo. Stem infection as dark irregular streaks is of common occurrence. Brinjal, *Ocimum, Leucas* and cotton show similar spotting but target type appearance is uncommon. In brinjal the lesions may coalesce to form irregular spots of 1 cm. size. Stem infection is not seen in these hosts. However dead stems of brinjal show velvety growth of the abundant conidiophores and conidia due to subsequent saprophytic colonization. Mature lesions on the above five hosts show abundant sporulation. *S. nigrum* L., *D. arvensis* and *S. jambolanum* develop minute, dark, non-sporulating spots. In the case of *S. jambolanum*, only seedlings at 6–8 leaf stage showed this type of infection and it was not noticed on trees.

Conidiophores are cylindrical, brownish, septate, with a bulbous basal cell. Conidia are obclavate to narrow cylindrical, in chains of 2 or 3, hyaline when young, later dark brown and thick-walled. They are porogenous and distoseptate, with a conspicuous hilum. Some abnormal bifurcate conidia have been noticed in the sporulating mass on dead stems of brinjal.

Isolates from all the hosts grow and sporulate well on potato-sucrose-agar (PSA). The range of the size of the conidia of the isolates in culture is 12·8-326·4 μ × 6·4-9·6 μ and 2-22 septate. Measurements of conidia and conidiophores from different hosts are given in Table I. The similarity of the conidia in culture is seen as against that of the natural materials which show greater variation.

TABLE I

Data on conidiophores and conidia of isolates of Corynespora cassicola *(in microns)*

Host	Conidia				Conidiophores			
	Length	Width	Hilum*	Septa	Length	Width	Bu. cell†	Septa
Chilli								
Max.	275·2	22·4	9·6	23	275·2	9·6	16·0	10
Min.	35·2	6·4	3·2	2	95·6	4·8	9·6	3
Brinjal leaf								
Max.	432·0	22·8	9·6	36	630·0	9·6	19·2	13
Min.	44·8	4·8	4·8	3	96·0	6·4	6·4	3
Brinjal dead stem								
Max.	153·6	20·8	9·6	17	672·0	9·6	16·0	17
Min.	27·2	4·8	3·2	2	102·0	6·4	8·0	3
Tomato leaf								
Max.	140·8	22·4	8·0	36	334·0	6·4	12·8	8
Min.	32·8	3·2	4·8	3	54·0	4·8	6·4	2
Ocimum sanctum L.								
Max.	134·4	16·0	9·6	18	217·6	9·6	16·0	7
Min.	32·0	4·8	3·2	3	54·6	6·4	8·0	2
Leucas aspera Spr.								
Max.	138·0	22·8	9·6	16	280·0	9·6	12·4	10
Min.	30·6	4·8	3·2	3	52·0	6·4	6·4	3
Gossypium hirsutum L.								
Max.	147	19·5	7·5	14	459·0	9·0	13·5	12
Min.	24	9·0	4·5	3	74·0	7·5	7·5	3

* Hilum: Diameter of the hilum. † Bu. cell: Bulbous basal cell of conidiophore.

Pathogenicity tests proved lack of host specificity among the 4 solanaceous isolates. Isolates of *Ocimum* showed pathogenicity both on *Ocimum* and brinjal. Isolates from *Syzygium*, *Leucas* and cotton were found to be pathogenic to brinjal but did not infect their respective hosts under our test conditions.

Irrespective of the source of the isolates, earliest symptoms were noticed in 5–7 days on chilli, *S. nigrum* L., *O. sanctum* L., and in 2 to 3 days on brinjal and tomato, the disease being severe on the latter two.

Out of the several hosts tried brinjal isolates were also pathogenic to soybean, sesame, *Cajanus cajan* Millisp. and *Abelmoschus esculentus*, Moench.

In India *C. cassiicola* has been reported on brinjal,[1] tomato,[5] papaw,[7] *Piper betle* L.,[8] castor,[4] rubber,[11] eucalyptus,[15] cassava,[10] *Justicia gendarussa* L.,[12] *Adathoda* sp., *Barleria cristata* L., *Carissa* sp., *Pycanthemum*,[9] *Rauwolfia serpentina* Benth.[6] and *Croton sparsiflorus* Mor.[13] It has been reported on chilli[2] from Australia.

Thus chilli, *S. nigrum* L., *O. sanctum* L., *L. aspera* Spr., *D. arvensis* Forsk., *S. jambolanum* D.C. and *Gossypium hirsutum*, L. are new host records for India.

Department of Botany,
S.V. University,
Tirupati, *July* 1, 1970.

Y. R. SARMA.
M. V. NAYUDU.

---

1. Asha Ram and Lele, V. C., *Indian Phytopath.*, 1968, **21**, 347.
2. Ellis, M. B., *Mycol. Pap.*, C.M.I., 1957, **40**, 65.
3. Jones, J. P., *Phytopathology*, 1961, **51**, 305.
4. Karan, D., *Mycopath. et. Mycol. appl.*, 1966, **30**, 187.
5. Mohanty, U. N. and Mohanty, N, N., *Sci. & Cult.*, 1955, **21**, 330.
6. Mohanty, N. N., *Ibid.*, 1958, **23**, 608.
7. — and Behera, B. C., *Proc. Ind. Sci. Cong. Assoc.*, 1960, p. 330.
8. — and Mahapatra, P. K., *Indian Phytopath.*, 1968, **21**, 275.
9. Munjal, R. L., and Gill, H. S., *Ibid.*, 1962, **15**, 269
10. Roy, A. K., *Ibid.*, 1965, **18**, 327.
11. Ramakrishnan, T. S., *Proc. Ind. Acad. Sci.*, Sect. B, 1960, **51**, 164.
12. Shome, S. K. and Mukharjee, N., *Sci. & Cult.*, 1964, **30**, 602.
13. Tirumalachar, M. J. and Lacy, R. C., *Sydowia*, 1951, **5**, 124.
14. Wei, C. T., *Mycol. Pap.*, C.M.I., 1950, **34**, 9.
15. Wilson, K. I. and Rema Devi, L., *Indian Phytopath.*, 1966, **19**, 393.

RESISTANCE OF SOME VARIETIES OF *MANGIFERA INDICA* L. TO SCALE INSECTS INFESTATION DUE TO FLAVONOIDS

DIFFERENT varieties of the mango trees (*Mangifera indica* L.) vary in their susceptibility to infestation with the soft scale insect *Lecanium acuminatum* Signoret. Studies on the population density of the insect in an orchard, cultivated with 9 varieties of *Mangifera indica* throughout seven successive months, show that *Timour* and *Pairi* varieties are the most resistant to infestation (average of 1·1–1·4 insects per an area of the leaf 1·5 × 2 inches). *Zebda* variety on the other hand is highly susceptible to the insect infestation (average of 16·2 insects per an area of the leaf 1·5 × 2 inches).

The general validity that acceptance or rejection of a plant was determined largely by its chemistry was firmly established by many authors. A chemical analysis of the leaves of different varieties of *M. indica* was therefore carried out aiming to find out any relation between the chemical constituents of the leaves of each variety and its susceptibility to infestation. The total nitrogen, phosphorus, carbohydrates, chlorophyll and carotenes were estimated but they showed no positive correlation with the degree of susceptibility in different varieties. A phytochemical screening of the powdered dry leaves of the three varieties mentioned was also carried out. Alkaloids were not detected, while tannins, polyphenols and unsaturated sterols were present in *Timour*, *Pairi* and *Zebda* varieties. Flavones, on the other hand, were detected in *Timour* and *Pairi* varieties only and which are resistant to infestation with the scale insect. In the *Zebda* variety which is highly susceptible to the scale insect infestation, there was no detection for any flavones. The test for flavones was carried out on the alcoholic extract of the powdered leaves which gave a deep red colour (+ve flavones) after treatment with 10% hydrochloric acid and magnesium turnings. Bate Smith (1952) found that *Mangifera indica* contained quercetin and kampferol which are polyhydroxy flavonoids without mentioning the tested variety. Kampferol is 3 : 5 : 7 : 4 tetrahydroxy flavone and quercetin is 3 : 5 : 7 : 3 : 4 pentahydroxy flavone. Indian chemists have known for a long time that polyhydroxy flavones were active insecticides and fish poisons.

From the foregoing results, it seems probable that the mango varieties containing flavonoids are resistant to infestation with the scale insect *Lecanium acuminatum*. Varieties containing no flavonoids, however, are highly susceptible to infestation.

National Research Centre, H. S. SALAMA.
Dokki, Cairo, U.A.R., G. WASSEL.
June 30, 1970. M. SALEH.

---

1. Bate Smith, E. W., *J. Linn. Soc. London*, 1952, **58**, 95.

OCCURRENCE OF AXILLARY BUDS IN AN INTERGENERIC HYBRID BETWEEN *SACCHARUM OFFICINARUM* L. AND *SCLEROSTACHYA FUSCA* A. CAMUS

IN an attempt to understand the probable origin of noble canes (*Saccharum officinarum*, L.) Parthasarathy[1] initiated cytogenetical studies on intergeneric hybrids between *S. officinarum* var. Vellai ($2n = 80$) and *Sclerostachya fusca* ($2n = 30$). The fourth back-cross to the recurrent parent, *Scleros. fusca* yielded a genotype, P' 751/1 wherein the entire complement of *Scleros. fusca* chromosomes ($2n = 30$) were implanted in the cytoplasm of *S. officinarum*. This presence of the *Scleros. fusca* chromosomes to the exclusion of *S. officinarum* complement was implicated in the absolute predominance of *Scleros. fusca* characters.[2]

In the course of studies on intergeneric hybrids in *Saccharum*, the above genotype, P' 751/1 was observed to possess axillary buds in the aerial culms, a character alien to *Scleros. fusca*. The buds were scaly in the genotype unlike the prominent plumpy buds of *S. officinarum*. Three pathways are suggested for the expression of this trait in the back-cross seedling: (*i*) the character is governed by cytoplasmic inheritance, (*ii*) the expression is genic through crossing-over of *S. officinarum* chromosomes homologous with *Scleros. fusca* as the homology of five chromosomes of *S. officinarum* with five of *Scleros. fusca* has been established by Govindaswami,[3] and (*iii*) an interaction between the *S. officinarum* cytoplasm and the chromosomes of *Scleros. fusca* resulting in the formation of scaly buds.

Sugarcane Breeding B. V. NATARAJAN.
Institute, J. T. RAO.
Coimbatore-7. *June* 29, 1970.

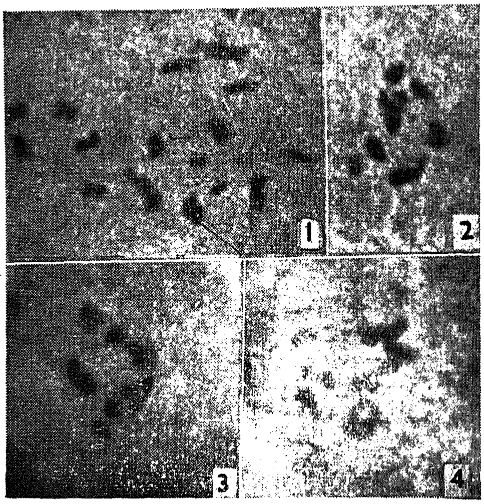
---

1. Parthasarathy, N., *Nature*, London, 1948, **168**, 383.
2. Raghavan, T. S., *Rep Sugarcane Breed. Inst.*, Coimbatore, 1956, p. 27.
3. Govindaswamy, S., *M.Sc. Thesis*, Madras University, 1948.

A CASE OF SEMI-STERILITY IN GRAM

THE chromosome number of $2n = 16$ in gram (*Cicer arietinum*) was first reported by Milovidov (1932).

In a population of chafa gram variety (*C. arietinum*) two plants with low seed-setting were observed at the Agricultural Research Station Niphad (Nasik District). The progenies of these plants segregated for normal and low seed-setting. These shy-bearing plants flowered profusely but produced a few pods and were known as semi-sterile. A few seeds of such plants were obtained by the senior author through the kind courtesy of Shri B. B. Chaudhari, the then Wheat Specialist, Niphad. Plants from these seeds were raised and studied in the seasons of 1964 and 1965. External morphology of semi-sterile and normal plants was same. Root tips and flower-buds of both the types were fixed in 1 : 3 propiono-alcohol and examined in propiono-carmine. They showed 16 chromosomes in the somatic cells (Fig. 1). Metaphase I of meiosis of the normal plants showed eight bivalents (Fig. 2). In the semi-sterile plants one quadrivalent either having the shape of a ring or a figure of eight (Figs. 3 and 4) was observed. In rare cases a trivalent and a univalent were also seen. The average chromosome association at metaphase I of the semi-sterile gram plant was $0{\cdot}44_{I} + 7{\cdot}25_{II} + 0{\cdot}02_{III} + 0{\cdot}25_{IV}$. Tetrads of unequal size were observed in 62% of the PMCs. Pollen grains were examined in 1% potassium-iodide-iodine solution. They showed 54% abnormal pollen grains. Seed-setting was less than 50%. The semi-sterile condition observed in the gram plants is evidently due to the segmental interchange between two non-homologous chromosomes. Reciprocal translocation giving rise to semi-sterility has also been reported by Brink (1927) in maize.



FIGS. 1–4, × 2,600 (Approx.) of *Cicer arietinum*. Fig. 1. Somatic metaphase showing $2n = 16$ chromosomes. Fig. 2. Meiotic metaphase I with 8_{II}. Fig. 3. Meiotic metaphase I of semi-sterile plant. 1_{IV} (ring) + 6_{II}. Fig. 4. Meiotic metaphase I of semi-sterile plant. 1_{IV} (figure of eight) + 6_{II}.

Botany Section,
College of Agriculture,
Poona-5, *June* 17, 1970.

RUI D'CRUZ.
A. S. JADHAV.

---

1. Brink, R. A., *Jour. Hered.*, 1927, **18**, 266.
2. Milovidov, P. F., *Preslia*, 1932, **11**, 62.

CIGAR-END DISEASE OF BANANA IN INDIA

DURING February 1970 a severe and extensive disease of banana fruits (*Musa paradisiaca* L.) was noticed during a survey of post-harvest diseases of fruits at the Jabalpur (M.P.) market. Isolations from the diseased fruits consistently yielded a species of *Verticillium*. On examination the fungus was identified to be *Verticillium theobromæ* (Turc.) Mason and Hughes (1):

The fruits get infected when they are still immature. The disease starts from the tip of the fruit where the withered perianth remains attached for some time and spreads upward. The diseased portion develops a rot and the fungus covers the rotted portion and produces conidiophores and conidia which are ashy in colour. This gives the disease the appearance of a burnt and ashy cigar-end. The diseased portion is delimited from the uninvaded healthy part by a blackish zone which gradually moves upwards as the rot develops further (Fig. 1). The decay covers even upto 1/3 length of the fruit. Later, the internal tissues develop a dry rot. Only a few fruits in a bunch get affected.

The pathogenicity of the fungus was confirmed by inoculating banana fruits at the perianth end. The inoculated fruits along with suitable checks were kept under bell jars with moist cotton to maintain humidity at room temperature (23-28° C.). The disease developed in the inoculated fruits both injured and uninjured within seven days. The checks did not develop any symptoms.

The mycelium of the fungus developed profusely on potato dextrose agar medium at 25° C. The hyphæ were much branched and septate. Abundant production of conidiophores and conidia was observed within 72 hours. The conidiophores were tapering and verticillate, solitary or in groups of two to six, erect, 105–410 × 3–5·5 μ, septate, cylindrical, thickened at the base, the verticillate branches were hyaline with pointed apices, three to five in each whorl, 21·5–32 × 2–4 μ. The conidia were formed at the ends of branches and assembled in globular translucent heads. The conidia readily dispersed in water. They were hyaline, oblong to cylindrical measuring 3·3–6·6 × 2–2·5 μ.

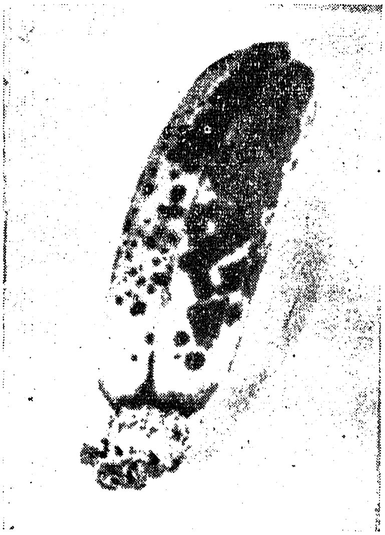


FIG. 1. Cigar-end disease of banana

Cigar-end rot of banana fruits has been reported from various countries (Wardlaw, 1961) but has not been reported from India so far and hence is reported as a new record for India.

The culture has been deposited in the Mycological Collection of the Department of Plant Pathology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, M.P.

The authors are grateful to Dr. D. P. Motiramani, Director, Research Service, for providing facilities.

Dept. of Plant Pathology,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya,
Jabalpur M.P., *June* 24, 1970.

O. D. DHINGRA.
M. N. KHARE.
J. N. CHAND.

---

1. Wardlaw, C. W., *Banana Disease*, Longmans Green & Co. Ltd., London, 1961, p. 413.

REVIEWS AND NOTICES OF BOOKS

Elements of Classical and Statistical Thermodynamics. By Nash. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W.1, England), 1970. Pp. viii + 128. Price 75 *sh*.

Using classical thermodynamics only, or statistical thermodynamics only, the able student may achieve impressive insight, but his progress becomes much swifter and more secure when he draws support from both ways of viewing equilibrium. That is the rationale for the present volume, in which an introduction to classical thermodynamics has been joined with a complementary account of statistical thermodynamics. Readily accessible to carefully taught college freshmen, these accounts are also well suited for independent study by more advanced students.

The book has been dealt with under two sections, *viz.*, Book One and Book Two.

Book One: To calculate from purely thermal data the position of equilibrium in a chemical reaction perhaps not even yet achieved—that is the problem towards which the entire argument of this section is directed. This argument has been shaped to highlight the physical content of thermodynamics as distinct from its purely mathematical machinery, and that machinery has been limited to a very few of the most elementary operations of the calculus, all of which are explained in an appendix.

Book Two: This section has been designed to show how new powers and new insights, operative in the realm of classical macroscopic thermodynamics, emerge from its affiliation with the microcosmic realm of atoms. To begin, analysis of very simple microcanonical ensembles leads to a derivation of the Boltzmann distribution law. Then, exploitation of this relation is shown to invest the concepts of entropy and equilibrium with new meaning and significance, and the reader comes to see how thermodynamic magnitudes (*e.g.*, gaseous heat capacities and equilibrium constants) can be calculated from spectroscopic data.

C. V. R.

Special Research Reports Translated from Russian. (Published by Consultants Bureau, New York-London, Plenum Publishing Corporation, 114, Fifth Avenue, New York, N.Y. 10011, U.S.A.), 1970.

Liquid-Phase Sintering, by V. N. Eremenko, Yu. V. Naidich and I. A. Lavrinenko, Pp. 75. Price $ 20.00.

One of the most promising methods of producing sintered materials of high density with the best combination of various properties is liquid-phase sintering. The present work examines liquid-phase sintering processes and the action of capillary forces in models of dispersed solid-liquid systems, and also gives data from theoretical and experimental studies in various metal and metal-ceramic systems. Some theoretical generalisations are also presented.

Silicon Cabide, Edited by Academician I. N. Frantsevich. Pp. 276. Price $ 35.00.

Silicon Carbide differs from other refractory compounds in that it has a wide range of useful properties ; it is a semiconductor, it is refractory, abrasion-resistant, corrosion-resistant, and retains its strength at high temperatures. This publication deals with many aspects of silicon carbide, both from theoretical and practical points of view.

The publication contains forty original research contributions grouped under the following main heads : (1) The Structure of Silicon Carbide ahd Equilibria in Systems containing it (9 papers); (2) Polycrystalline Materials based on Silicon Carbide (10 papers); (3) Monocrystalline Silicon Carbide (21 papers).

Propagation of ELF and VLF Waves Near the Earth. By Ya. L. Al'pert and D. S. Fligel', Pp. 171. Price $ 22.50.

Interest in the propagation of extremely low frequency (ELF, 1-3000 hertz) and very low frequency (VLF, 3 kHz-30 kHz) electromagnetic waves has greatly increased over the past ten years. Most diverse problems are encountered in dealing with them. Principally they require the laws of propagation of these waves in the waveguide region bounded by the earth's surface and the lower part of the ionosphere, i.e., the "earth—ionosphere waveguide". The present monograph is devoted mainly to the consideration of this topic. The thirteen chapters of the book present a concise summary of known knowledge on the subject to date. The bibliography contains 392 references.

A. S. G.

Books Received

Handbook of Atomic Elements. By R. A. Williams. (Philosophical Library, Inc., 15, East 40th Street, New York, N.Y. 10016), 1970. Pp. 124. Price $ 6.00.

Applied Numerical Analysis. By C. F. Gerald. (Addison-Wesley Pub. Co., West End House, 11, Hills Place, London W.1), 1970. Pp. xii + 340. Price 72 *sh.*

Art in Organic Synthesis. By Nitya Anand, J. S. Bindra and S. Ranganathan. (Holden-Day, Inc., 500, Sansome Street, San Francisco), 1970. Pp. xiv + 414. Price $ 11.00.

Tracer Diffusion Data for Metals, Alloys and Simple Oxides. By John Askill. (Plenum Pub. Corpn., New York, 10011 N.Y.), 1970. Pp. viii + 107. Price $ 12.50.

2327-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, at The Bangalore Press, Bangalore-18.

NUCLEIC ACIDS IN THE DISSOLVED CONSTITUENTS OF SEA-WATER

T. N. V. PILLAI AND A. K. GANGULY

Health Physics Division, Bhabha Atomic Research Centre, Bombay-85, India

ABSTRACT

A method is described to obtain the dissolved constituents of nucleic acid from sea-water by adsorption on *in situ* precipitated $BaSO_4$. The nucleic acid is liberated as hydrolysate in 0·02 N HCl under controlled conditions. The UV spectra, $\epsilon(P)$ value, and deoxyribose of the hydrolysate are compared with standard DNA and RNA hydrolysates obtained under similar conditions. The effect of NaCl treatment, amount of *in situ* precipitated $BaSO_4$, temperature, period of hydrolysis, etc., are investigated to obtain pure nucleic acid components from the sea-water system. The recovery of the method is determined using standard DNA and processing the sample under similar conditions.

INTRODUCTION

SEA-WATER contains a variety of organic compounds in the dissolved state in the concentration range of 0·2 to 2·7 mg./l in carbon equivalents. Duursuma,[1] Hood,[2] Skopintsev,[3] Kay[4] and Tatsumato *et al.*[5] have listed the different classes of organic compounds identified in sea-water. Belser[6] obtained indirect evidences for frequent occurrence of uracil and occasional presence of purines in the dissolved state. Hansen *et al.*[7] have observed the presence of nucleic acid in the suspended matter retained on filter-paper. In the course of our investigation, with coastal sea-waters of Bombay, on the role of different organic constituents in the formation of organo-metallic complexes, we have found that sea-water contains a significant concentration of nucleic acid in the dissolved state (probably in the nucleoprotein form). The present paper describes the procedure adopted to separate the dissolved nucleic acid from sea-water and to characterise and estimate the same.

EXPERIMENTS AND OBSERVATIONS

After a number of trial experiments, the following procedure was found to give the best result. Freshly collected sea-water from Bombay Harbour Bay was filtered.* One litre of the filtered sample was kept stirred and to it was added 2·5 ml. of 1% barium chloride slowly in drops (giving 24 mg. *in situ* precipitated $BaSO_4$). Stirring was continued for 2 hours at room temperature (25° C.) and the barium sulphate precipitate was allowed to settle. Supernate centrifuged for 15 minutes at 5600 x g. The precipitate was transferred to a 15 ml. centrifuge tube with distilled water and centrifuged for 15 minutes. The precipitate was washed and centrifuged twice with 10 ml. distilled water and then kept dispersed in 3 ml. of 1 M NaCl for 16 hours by intermittent shaking. The supernate was collected after centrifugation. Residue was washed with 2 ml. of 1 M NaCl, centrifuged and the supernate pooled with the earlier one and filtered. UV spectrum of the 1 M NaCl extract was taken against an appropriate blank (Fig. 1 *a*). To the precipitate was added 5 ml. of 0·02 N HCl and kept for hydrolysis in a water-bath at 100° C. for 3 hours with occasional stirring. The sample was then cooled to room temperature, centrifuged and the hydrolysate filtered. The precipitate was washed with a few drops of distilled water, centrifuged, filtered and added to the main bulk of the filtrate, volume was made upto 5 ml. and the UV spectrum of the hydrolysate taken against an appropriate blank. Figure 1 *b* shows the maximum and minimum respectively at 260 mμ and 230 mμ. Figure 1 *c* represents the combined spectrum of the hydrolysate and the NaCl extract. Figure 2 gives the UV spectra of standard DNA† (calf-thymus) and RNA** (yeast) after hydrolysis with 0·02 N HCl under the same conditions as for the sample. Figure 3 gives the UV spectra obtained with standard DNA in 1 M NaCl containing sodium sulphate in concentration equal to that in sea-water and treated similarly as the filtered sea-water sample.

Phosphate content in the hydrolysates was estimated by the method of Meun and Smith[8] and the results are given in Table I.

Carbohydrate contents in the hydrolysates were estimated using the diphenylamine method[9] for deoxyribose. The results are given in Table II.

---

* 0·22 μ Millipore membrane filters were used in all filtration procedures in the present work.

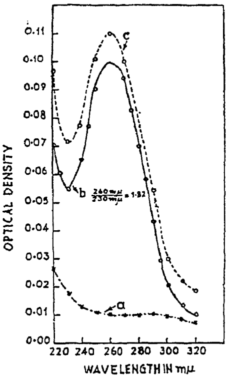
† Obtained from Sigma Laboratories, USA.

** Obtained from Nutritional Biochemical Corporation, Cleveland, Ohio, USA.

DISCUSSION

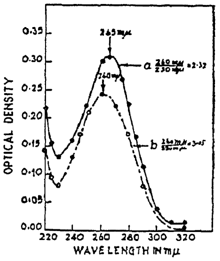
Figure 1 *b* is typical of nucleic acid and compares very well with the standard DNA and RNA in its general features. The supernate after the first precipitation of $BaSO_4$ was treated with barium chloride again to investigate further sorption of nucleic acid, if any left. There was no indication of the presence of nucleic acid in it and Fig. 3 *b* gives the spectrum of the supernate after $BaSO_4$ precipitation in standard DNA solution. At the concentration used, DNA is observed to be picked up about 98% by precipitating $BaSO_4$ under

FIG. 1.–UV SPECTRA OF SAMPLE EXTRACTS FROM PRECIPITATED $BaSO_4$



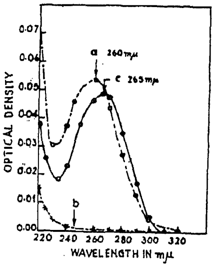
(a) 1 M NaCl EXTRACT
(b) HYDROLYSATE IN 0.02 N HCl
(c) COMBINED SPECTRUM OF NaCl EXTRACT AND THE HYDROLYSATE

FIG. 2.–UV SPECTRA OF STANDARD DNA AND RNA AFTER HYDROLYSIS IN 0.02 N HCl



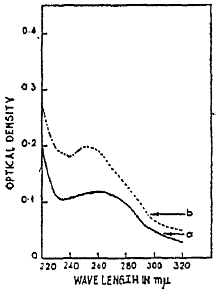
(a) STANDARD DNA (9·52 μg/ml)
(b) STANDARD RNA (9·52 μg/ml)

FIG. 3.–UV SPECTRA OF STANDARD DNA



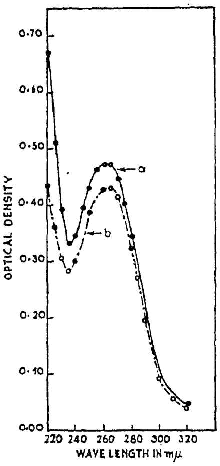
(a) STANDARD DNA IN 1 M NaCl (3·65 μgs/ml)
(b) FILTRATE AFTER $BaSO_4$ PRECIPITATION
(c) HYDROLYSATE IN 0.02 N HCl

FIG. 4.–UV SPECTRA OF THE HYDROLYSATE ($BaCl_2$ USED TO GIVE 48 mgs OF $BaSO_4$)



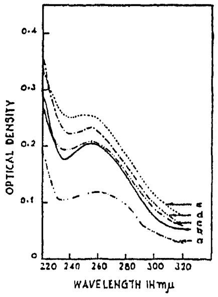
(a) HYDROLYSATE WITH NaCl TREATMENT
(b) HYDROLYSATE WITHOUT NaCl TREATMENT

FIG. 5.–UV SPECTRA OF HYDROLYSATE ($BaCl_2$ USED TO GIVE 96 mgs OF $BaSO_4$) AFTER NaCl TREATMENT



(a) HYDROLYSATE DIRECT
(b) HYDROLYSATE AFTER PURIFICATION WITH OCTYL ALCOHOL-CHLOROFORM (1:5) MIXTURE

FIG. 6.–UV SPECTRA OF THE HYDROLYSATE OBTAINED FROM PRECIPITATED $BaSO_4$ USING DIFFERENT AMOUNTS OF BARIUM CHLORIDE



(a) 48 mgs OF $BaSO_4$ AND 40 HOURS OF 1 M NaCl TREA.
(b) 96 mgs ... ...
(c) 144 mgs ... ...
(d) 192 mgs ... ...
(e) 240 mgs ... ...

FIGS. 1–6

neutral condition, whereas under acid condition (0·04 N acid) the adsorption has been found to be poor (~ 50%). The recovery from $BaSO_4$ by the hydrolytic procedure as indicated by UV spectra has been 86% (Fig. 3 c).

The NaCl pretreatment of $BaSO_4$ as described gives hydrolysate agreeing very closely with standard DNA hydrolysate—the ratio of optical density at 260 mμ to 230 mμ for hydrolysates of different samples ranges between 1·8 and 2·2 in agreement with values observed for DNA (*cf.* Ref. 10).

The NaCl extracts in all cases were found positive to biuret test; the extract was not analysed for any other constituent. Figure 4 compares the UV spectra of the hydrolysates obtained by the procedure detailed with and without NaCl pretreatment. The lower ratio of optical density at 260 and 230 mμ for the hydrolysate without NaCl treatment and high absorption values are indicative of protein contamination of the hydrolysate. Figure 5 *a* gives the UV spectrum of nucleic acid obtained from 1 litre of filtered sea-water, using barium chloride to give 96 mg. of $BaSO_4$. The high absorption in the low wavelength region indicated contamination and this sample on shaking with octyl alcohol-chloroform mixture (1 : 5) and removal of the organic phase has the absorption spectrum as in Fig. 5 *b*. NaCl treatment has been observed to be critical in ensuring the retention of only the nucleic acid fraction on $BaSO_4$ and removal of other constituents. Figure 6 gives UV spectra of the hydrolysates obtained from $BaSO_4$ precipitated in sea-water with different quantities of barium chloride. The high UV absorptions are associated with high pick-up of interfering dissolved organic matter in the sea-water. The recovery obtained in the hydrolysate from large quantities of $BaSO_4$ has also been observed to be poor. The optimum precipitation of 24 mg. of $BaSO_4$ from one litre of sea-water was derived from these observations. Further, it was necessary to ensure a constant temperature at 100° C. to obtain the optimum hydrolytic product. Longer period of hydrolysis progressively changes the UV characteristics of the hydrolysate.

ε (P) values at 260 mμ calculated, using Figs. 1 *b*, 2 *a* and 2 *b* and the data in Table I, are given in Table III. They ranged from 8150 to 11100 in good agreement with the values obtained for the standard nucleic acids.

TABLE I

Phosphorous content in the hydrolysate

Sea-water sample collected on	Phosphorous content μg./ml. of hydrolysate	Phosphorous content μg./ml. calculated from the DNA content in the hydrolysate
25–6–1970	0·3685	0·3804
14–7–1970	0·2996	0·2632
21–7–1970	0·6852	0·4944
4–8–1970	1·6150	1·6530

Standard DNA (9·52 μg./ml.) = 0·9763 μg./ml.

TABLE II

Deoxyribose nucleic acid in the hydrolysate

Sea-water sample collected on	Deoxyribose by diphenylamine method in units of μg. of DNA
25–6–1970	18·55
14–7–1970	13·44
21–7–1970	24·12
4–8–1970	80·63

TABLE III

ε (P) value of hydrolysates

Sea-water sample collected on	ε (P) value at 260 mμ
25–6–1970	11730
14–7–1970	10250
21–7–1970	9020
4–8–1970	9046
Standard DNA (9·52 μg./ml.)	9552

The results of deoxyribose estimation, given in Table II, are expressed in equivalents of μg. of DNA by comparing the sample readings with that of the standard nucleic acid. The values thus can also be read as the μg. of DNA present in one litre of the sea-water samples collected on different dates. The DNA concentration given in Table II was used to calculate the phosphorous content in the hydrolysate and the data are presented in the third column of Table I. The calculated values are in good agreement with the values obtained by direct estimation except for one sample. Orcinol method[9] was used in an attempt to estimate the pentose content. The results obtained were 2-3 times higher than the deoxyribose content and as such this could not be correlated with the phosphorous estimation. It is possible that *in situ* precipitated $BaSO_4$ while absorbing nucleic acid, adsorbs also the polysaccharides present in the sea-water filtrate and as such RNA content, if any, in the sea-water collected on 21st

July 1970 could not be made. Further work is in progress.

1. Duursuma, E. K., "The dissolved organic constituents of sea-water," *Chemical Oceanography*, Riley and Skirrow (editors), Academic Press, London and New York, 1965, Chapter 11, p. 433.
2. Hood, D. W., *Chemical Oceanography*, *Oceanogra*, *Marine Biol. Ann. Rev.*, Harold Burnes (editor), George Allen & Unwin Ltd., London, 1963. **1**, **129.**
3. Skopintsev, B. A., *Organic Matter in Sea-Water*, *Preprints*, Inst. Oceanogra. Congr., Edited by M. Sears, Am. Assoc. Advance of Sci., Washington, **1959**, p. **953.**
4. Kay, H., "A micro method for the chemical determination of organic carbon in sea-water," *Kieler Meersforsch*, 1963, **10**, 26.
5. Tatsumoto, M., Williams, W. T., Prescott, J. M. and Hood, D. W., 'Amino-acid in samples of surface sea-water," *J. Mar. Res.*, 1961, **19**, **89.**
6. Belser, W. L., "Bioassay of organic micronutrients in the sea," *Proc. Natl. Acad. Sci. U.S.*, 1959, **45**, 1535.
7. Hansen, O. H., Sutcliffe, W. H. Jr. and Sharp, J., "Measurement of deoxyribonucleic acid in the ocean and its ecological significance," *Limnology and Oceanography*, July 1918, **13** (3), 507.
8. Meun, H. C. and Smith, K. C., "A microphosphate method," *Anal. Biochem.*, 1968, **26**, **364.**
9. Chargraff, E. and Davidson, J. N., *The Nucleic Acid*, Academic Press, New York, 1955, **1.**
10. Cantoni, G. L. and Davies, D. R., *Procedures in Nucleic Acid Research*, **A Harper International** edition, Harper & Rao, New York, **1967**, **p. 555.**

ON SOME INTERSTITIAL FAUNA IN THE MARINE SANDS ON INDIAN COAST

G. CHANDRASEKHARA RAO

Zoological Survey of India, Calcutta-13

AMONG the various groups of interstitial fauna of marine sands, the ostracods are little known due to their meagre representation in the habitat. Likewise information on the psammophilous halacarid fauna is limited, except for the work carried out on European[1] and North American[2] coasts. The only report of the fauna on Indian coast is that by Chandrasekhara Rao and Ganapati[3] on the beach sands of Waltair Coast. During various faunistic surveys undertaken by the Zoological Survey of India, the author had opportunity to study collections of the fauna from different areas on Indian coasts, including the Andamans. The present paper is concerned with two ostracods (Part I), and the salt-water mite *Halacarus anomalus* (Part II).

Part I. On the Occurrence of Two Interstitial Ostracods (Crustacea) on Indian Coast

Among the ostracods encountered, the occurrence of two European species on Indian coast is interesting and the following is a brief report on them.

Sub-order : Podocopa.
Family : Cytheridae.
Sub-family : Microcytherinae.
Genus : *Microcythere* Muller.

Microcythere subterranea Hartmann

Material.—1 ♂ + 3 ♀, Puri (Orissa), 16th December 1966; 1 ♀, Konarak (Orissa), 18th December 1966; 2 ♂ + 7 ♀, Waltair (Andhra), 16th November 1968; 3 ♂ + 8 ♀, Mayabunder (N. Andaman), 29th March 1969; 2 ♀, Cheriatapu (S. Andaman), 6th April 1969; 1 ♂ + 5 ♀, Car Nicobar, 13th March 1969 (all collected by G. C. Rao); 1 ♂, Mangalore (Mysore), 17th December 1966 (collected by A. N. P. Ummerkutty).

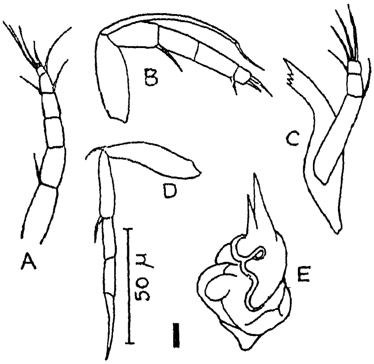
Remarks.—Hartmann[4] described the species from the intertidal sands on French coast of the Mediterranean Sea. Later, Renaud-Debyser[5] reported the species at Arcachon on the Atlantic coast. This species has now been recorded for the first time on the west coast and Andamans. The specimens collected on Indian coast agree fairly well with the description and figures given by Hartmann. The Indian forms measure 0·18-0·20 mm. in length and 0·06-0·07 mm. in width. The terminal segment of the antennule bears a modified seta, not reported in the type.

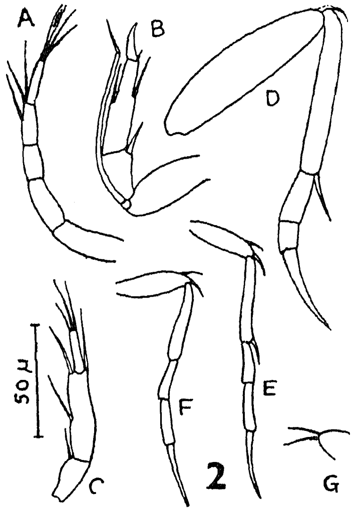
Sub-family : Loxoconchinæ.
Genus : *Microloxoconcha* Hartmann.

Microloxoconcha compressa Hartmann

Material.—2 ♂ + 5 ♀, Waltair (Andhra), 16th November 1968; 2 ♂ + 7 ♀, Mayabunder

(N. Andaman), 29th March 1969; 3 ♀, Rangat Bay (M. Andaman), 24th March 1969; 2 ♂ + 6 ♀, Car Nicobar, 13th March 1969 (all collected by G. C. Rao); 4 ♀, Mangalore (Mysore), 17th December 1966 (collected by A. N. P. Ummerkutty).





FIGS. 1–2. Fig. 1. *Microcythere subterranea* Hartmann. A, Antennule; B, Antenna; C, Mandible; D, Walking leg; E, Penis. Fig. 2. *Microloxoconcha compressa* Hartmann. A, Antennule; B, Antenna; C, Mandibular palp; D, First leg; E, Second leg; F, Third leg; G, Caudal furca.

Remarks.—Hartmann[4] described this species also from the intertidal sands on French coast of the Mediterranean Sea. The ostracod, which was not reported later, has now been recorded for the first time on the west coast and Andamans. The present material is strikingly similar to the description and figures given by Hartmann. The Indian specimens measure 0·26–0·27 mm. in length and 0·10–0·11 mm. in width. Characteristic appendages of the species are shown in Fig. 2. A pointed tubercle on the dorsal surface of the second segment of the mandibular palp, described for Mediterranean specimens, is not observed in the local forms.

Ecological Notes.—Although the present knowledge of the geographical distribution of interstitial Ostracoda is still incomplete due to lack of sufficient data from other parts of the world, the occurrence of the two European species on Indian coast throws considerable light on the ubiquitous nature of the fauna and shows their tolerance to diverse environmental factors. During the investigation on Waltair coast, it was found that both the species occur in the same biotope throughout the year in small numbers. In most of the beaches studied, the forms inhabit medium sands 5–40 cm. below surface near half-tide level. The texture of the sands ranged from 200 µ to 500 µ in mean diameter. The organic detritus appeared rich in some of the finer substrates. The temperature in the habitat varied from 24° C. to 29° C., while the salinity of interstitial water ranged between 24‰ and 33‰. The sands are associated with low values of dissolved oxygen compared with adjacent seawater.

Of the two species, *Microcythere subterranea* is smaller in size and perfectly adapted for life in minute interstices between sand grains. The species is agile and keeps always rapidly walking over the surfaces of sand grains. It is highly thigmotactic and firmly adheres to the substrate even to slightest disturbance in the habitat. The ostracods are omnivorous, feeding on fine particles of detritus, bacteria and smaller protozoans. The two species are often found to occur in company, as has been reported in the Mediterranean habitat also (see Hartmann[4]).

Part II. Occurrence of the Salt-Water Mite *Halacarus anomalus* Trouessart in the Intertidal Sands on Indian Coast

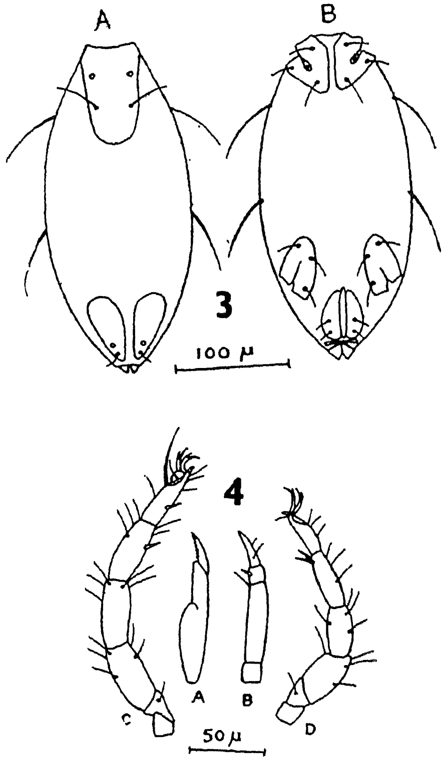
Halacaridæ or the salt-water mites form one of the constituent groups of marine interstitial community inhabiting intertidal sands. Of the species encountered, the mite *Halacarus anomalus* Trouessart (Fig. 3) was common in the collections, presenting some interesting features in its structure, habits and distribution.

Material.—1 ♂ + 13 ♀, Puri, 15th December 1966; 2 ♀, Konarak, 18th December 1966; 9 ♀, Waltair, 16th November 1968; 1 ♂ + 14 ♀, Mayabunder, 29th March 1969, 3 ♀, Rangat Bay, 24th March 1969; 3 ♀, Cheriatapu, 6th April 1969; 6 ♀, Car Nicobar, 11th March 1969 (all collected by G. C. Rao); 2 ♀, Coondapur, 31st December 1966 (collected by A. N. P. Ummerkutty).

Remarks.—Except for some minor variations, the specimens on Indian coast conform to the description of the species given by Andre.[6] The European specimens are known to reach 600 μ in length including rostrum, while the Indian specimens are smaller measuring only 270-290 μ long to the base of capitulum. Ocular plates are absent. Each platelet of the posterodorsal plate is pierced by a pore and bears a seta. Each platelet of the anterior and posterior epimeral plates bears three setæ. Genital plate is separate from anal plate and is divided into right and left halves, each bearing two setæ. A narrow transverse sclerite separates the genital and anal plates. Measurements of the appendages are as follows (approx.): chelicera 96 μ, palp 108 μ, I leg 260 μ, II leg 186 μ, III leg 172 μ, IV leg 176 μ. Lateral claws of the legs bear an accessory tooth and are non-pectinate. The joints I_5 and I_6 bear a ventral spine each. I_6 bears unidentate median claw and two pairs of parambulacral setæ. Bacillum and parabacillum are present on the inner aspect. II_5 has two pairs of pectinate ventral setæ. II_6 has a prominent claw fossa and a pair of lateral parambulacral setæ. Legs III-IV are similar to II (Fig. 4).

The present study has shown that the species is widely distributed throughout the year, occurring in moderate numbers. In most of the beaches investigated, the species showed preference for substrates with sufficient coarse particle size, ranging from 300 μ to 600 μ in mean diameter. The acarine colonises and thrives at all horizontal and vertical levels of the intertidal zone, indicating its adaptability to diverse physico-chemical conditions of the environment.

The majority of acarines have not shown any specialised modification for progression in interstices and simply crawl over the surface of sand grains with the help of legs. *Halacarus anomalus* is, however, modified in structure to adapt itself to life in minute interstices between sand grains. Its body is cylindrical and the legs are disposed at the extreme ends of body, enabling the mite to move through interstices in any direction with considerable ease. The form is sluggish and thigmotactic, grasping sand grains when the capillary waters are in motion. The acarine is omnivorous, feeding on detritus, bacteria and other smaller organisms such as protozoans, nematodes, gastrotrichs, ostracods and copepods. The species is gregarious in habits and the occurrence of males to females is about 1 : 13.



FIGS. 3-4. Fig. 3. *Halacarus anomalus* Trouessart female. A, Body, dorsal view; B, Same, ventral view Fig. 4. *Halacarus anomalus* Trouessart; A, *Chelicera*; B, Maxillary palp; C, First leg; D, Second leg.

This species has a wide geographical distribution and has been commonly reported on the coasts of Baltic, North Sea, Gulf of Gascogne, Mediterranean and the Atlantic coast of North America. The present records of the halacarid in India are made on the coasts of Orissa, Andhra, Mysore and the Andaman Archipelago. As more intensive surveys of the fauna are carried out at different parts of the world, it is possible that the zoogeographical range of the species will continue to change, revealing a cosmopolitan distribution.

The author is grateful to Dr. A. P. Kapur, Director, Zoological Survey of India, Calcutta, for providing necessary facilities to carry out this work.

1. Delamare Deboutteville, C., *Biologie des eaux souterraines littorales et continentales*, Hermann, Paris, 1960, p. 740.
2. Newell, I. M., "A systematic and ecological study of the Halacaridæ of eastern North America," *Bull. Bingham Oceanogr. Coll.*, 1947, **10**, 232.
3. Chandrasekhara Rao, G. and Ganapati, P. N., "The interstitial fauna inhabiting the beach sands of Waltair coast," *Proc. natn. Inst. Sci. India* 1968, **34** (2), 82.
4. Hartmann, G., "Ostracodes des eaux souterrainee littorales de la Mediterane et de Majorque," *Vie et Milieu*, 1954, **4** (2), 238.
5. Renaud-Debyser, J., "Researches ecologiques sur la faune interrstitielle des sables (Basin d' Arcachon; ile de Bimini, Bahamas)," *Ibid.*, 1963, Suppl. 15, p. 157.
6. Andre, M., Halacariens marins," *Faune de France*, 1946, **46**, 152.

ON THE FREE AMINO-ACIDS OF THE HAEMOLYMPH AND REGIONS OF THE ALIMENTARY CANAL OF *EYPREPOCNEMIS ALACRIS ALACRIS* (SERVILLE) (ORTHOPTERA : INSECTA)

M. C. MURALIDHARAN AND T. N. ANANTHAKRISHNAN
Entomology Research Unit, Loyola College, Madras-34

ABSTRACT

The distribution and the relative concentrations of the free amino-acids of the hæmolymph of the late instars and adult females under diverse physiological conditions as well as the free amino-acids of the various regions of the alimentary canal of the V instar and adult females of *Eyprepocnemis alacris alacris* (Serville) are discussed.

CONSIDERABLE information on the free amino-acids of the post-embryonic and adult stages of several insects is available[4-7] although the free amino-acids of Acridids in particular appear to be confined to the hæmolymph of the nymphs of *Locusta migratoria*,[6] *Schistocerca gregaria*,[2] *Anacridium œgyptium*[1] and *Acrida exaltata*.[11] Colombo *et al.*[3] have also investigated the free amino-acids of the eggs during embryonic development of *Schistocerca gregaria*.[7]

Information relating to the free amino-acids of the various regions of the alimentary canal appears to be lacking in the case of Acridids. Data presented here pertains to the qualitative studies on the distribution of the free amino-acids of the fore, mid and hindgut of the V instar and adult females of *Eyprepocnemis alacris, alacris*, as also the free amino-acids of the hæmolymph of the IV, V instars and adult females under three different physiological conditions, *viz.*, females on the '0' day, *i.e.*, immediately after hatching to adult, mature females (12-15 days), as well as the starved females.

Samples of hæmolymph from the hind-femora and abdomen were collected on a Whatman No. 1 filter-paper, dried, kept for 24 hours in 90% ethanol and was concentrated before spotting. Regions of the fore, mid and hindgut, removed after dissection in distilled water, were separately ground, centrifuged and stored after adding few drops of isopropyl alcohol. Trichloroacetic acid was added before centrifuging so as to precipitate the minor proteins, peptides, etc.

The extracts were spotted on Whatman No. 1 filter-paper and both two-dimensional and circular methods were employed, using in both cases the same solvent (*n*-butanol : acetic acid : water)) in the ratio of 4 : 1 : 1. After a run of about 10-12 hours at room temperature, the paper was sprayed with 0·2% (W/V) ninhydrin. For the two-dimensional method, phenol : water solvent was also used in the ratio of 3 : 1. Chromatograms of standard amino-acids were also prepared for comparison and the results tabulated.

The free amino-acid patterns of the hæmolymph from the V instar onwards shows that lysine, histidine, serine, glycine, aspartic acid are present in appreciable concentrations, with a fall in concentration in the starved individuals. Serine has also been reported to be present in the hæmolymph of *Schistocerca gregaria* as in *Eyprepocnemis alacris alacris*, but has not been reported in *Locusta migratoria* and *Anacridium œgyptium*. On the '0' day, a decline in the concentrations of glutamic acid, threonine (absent in *Acrida exaltata*[11]),

TABLE I

Showing the free amino-acids in the hæmolymph and in the alimentary canal of Eyprepocnemis alacris alacris (*Serville*)

Amino-acids	Hæmolymph					Alimentary canal					
	IV instar	V instar	Adult female '0' day	Adult female matured	Adult female starved for 2 days	Foregut		Midgut		Hindgut	
						V instar	Adult	V instar	Adult	V instar	Adult
Lysine	+	++	++	++	+	+	+	+	+	+	+
Histidine	+	++	++	++	+	+	+	+	+	+	+
Arginine	+	−−	+	−−	+	−	−	+	+	−	−
Serine	+	++	++	++	+	+	+	+	+	+	+
Glycine	+	++	++	++	+	+	+	+	+	+	+
Aspartic acid	+	++	++	++	+	+	+	+	+	+	+
Glutamic acid	+	++	⊕	+	−	+	+	++	+	−	+
Threonine	+	++	⊕	+	−	+	+	++	+	−	+
Alanine	+	+	⊕	+	−	+	+	++	+	+	+
Proline	+	+	+	+	+	−	−	−	−	−	−
Tyrosine	+	+	⊕	+	−	⊕	−	⊕	+	⊕	−
Valine	+	+	⊕	++	⊕	⊕	⊕	+	+	⊕	⊕
Methionine	+	+	⊕	++	⊕	⊕	⊕	+	+	⊕	⊕
Phenylalanine	−	−	−	⊕	−	−	−	−	−	−	−
Leucine	+	+	⊕	+	+	+	+	+	+	+	+
Tryptophan	+	+	⊕	+	⊕	−	−	+	+	−	−

+ = Present, − = Absent, ++ = Concentrated, ⊕ = Traces.

alanine, tyrosine and leucine is noticed, with a subsequent increase in the normal adult. The meagre presence of tyrosine on the '0' day might appear to be due to its utilisation for the pigmentation process as suggested for *Culex* sp.[5] Subsequently, starvation resulted in the absence of some amino-acids, almost as in '0' day condition (Table I). The low concentration of these amino-acids on the '0' day appears to be due to the cessation of feeding for some time before and after ecdysis or possibly be due to the fact that some amino-acids were being used up during ecdysis as in the case of tyrosine. The presence in smaller concentrations of glutamic acid, alanine, proline and tyrosine on the '0' day also confirms the earlier observations that these amino-acids take an active role in the synthesis of cuticle proteins, chitins, etc.,[11] and after moulting, in the adult stage these increase in quantity. Phenylalanine is found only in traces in the adult condition while it is absent in the earlier instars.

The free amino-acids of the alimentary canal show clear differences among the three regions. The fore and hindgut present the same amino-acid picture while the midgut differs (Table I). However, no significant changes during transition from V instar to adult were noticed in the alimentary canal, with respect to amino-acid picture except that serine, glycine, aspartic acid, glutamic acid, threonine and alanine were in higher concentration in the midgut region of the V instar than in the adult. Phenylalanine was absent in both V instar and adult in all the three regions as has been recorded in many insects.[9] The absence of this essential amino-acid may be indirectly explained on the basis, that phenylalanine gets converted readily to tyrosine in the insect body[9] and this conversion has already been recorded by Fukuda.[8] Tyrosine appears to be absent in the extracts of the fore and hindgut and is present only in the midgut, but in the V instar all the three regions have tyrosine but in small concentrations.

Thanks are due to Prof. Dr. A. Srinivasan of the Chemistry Department for help rendered during this investigation.

1. Benassi, C. A. *et al.*, *Experientia*, **1959**, **15**(12), 457.
2. —, *Biochem. J.*, 1961, **80**, 332.
3. Colombo, G. *et al.*, *Comp. Biochem. Physiol.*, 1962, **5**, 83.
4. Chen, P. S., *Amino-acid Pools*, Ed. J. T. Holden, 1962, p. 115.
5. — and Briegel, H., *Comp. Biochem. Physiol.*, 1965, **8**.
6. Duchateau, G. H. *et al.*, *Arch. int. Physiol.*, 1952, **60**, 539.
7. Marcel Florkin, *IV Intl. Cong. Biochem. Vol. XII. Biochemistry of Insects*, 1959.
8. Fukuda, T., *Proc. IV Intl. Cong. Biochem.*, Vienna, 1958.
9. Kamlesh Dang and Pant, J. C., *Indian J. Ent.*, **1964**, **26**, 268.
10. Pant, R. and Agrawal, H., *Curr. Sci.*, **1963**, **32**, 20.
11. —, *J. Insect Physiol.*, **1964**, **10**, **443**.

LETTERS TO THE EDITOR

THE ELECTRONIC EMISSION SPECTRUM OF THE MgBr MOLECULE

THE spectrum of MgBr has been studied both in emission and absorption.[1,2] According to Morgan[3] the spectrum of MgBr consists of double-double-headed bands degraded to shorter wavelengths in the region λλ 3800–3950 Å. The system was attributed to $A^2\Pi$-$X^2\Sigma$ transition, with a doublet separation of 110 cm.$^{-1}$ in the upper $A^2\Pi$ state. From a partial rotational analysis of the (0, 0) band of A–X system Patel and Patel[4] confirmed the transition of the system as $^2\Pi$-$^2\Sigma^+$. Harrington[5] investigated the spectrum in absorption and reported a number of bands degraded to longer wavelengths in the region λλ2540–2850 Å in addition to the bands of the A–X system, reported by Morgan. The analysis of these bands was carried out on the basis of two sub-systems designated as C_1-X and C_2-X with a separation of about 110 cm.$^{-1}$ between C_1 and C_2 levels. The C_1 and C_2 levels are regarded as the two components of a $C^2\Pi$ state. The ΔG intervals of the lower state of the system as reported by Harrington does not agree with the corresponding intervals of the $X^2\Sigma$ state. As the bands of the system are single-headed, the assignment of the system to a $^2\Pi$-$^2\Sigma$ transition appears to be doubtful.

A new study of the spectrum of MgBr has been made by exciting the spectrum in emission in a high frequency discharge (40 MHz) from a 500-watt oscillator by passing bromine and argon over heated magnesium metal in a quartz discharge tube. The spectrum has also been excited using an anhydrous sample of $MgBr_2$ in the presence of argon. In both the discharges the spectrum of MgBr revealed the presence of A–X and C–X systems reported previously. The bands of the C–X system are photographed on a Hilger medium quartz spectrograph with a dispersion of 5 and 15 Å mm.$^{-1}$ at λλ 2000 and 3000 Å respectively. Exposure of 5-10 minutes gave good spectrum using Ilford Special Rapid and N 30 plates.

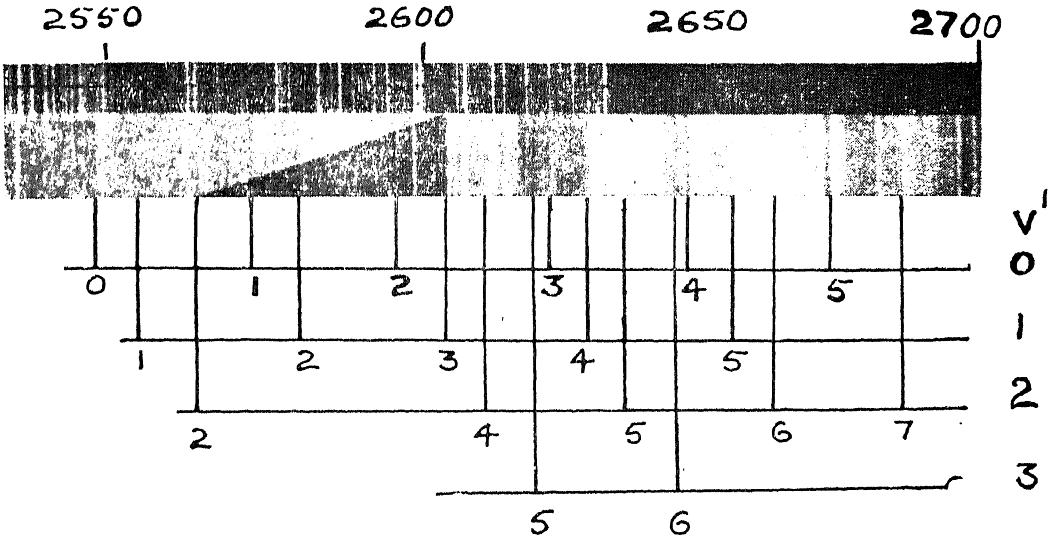


FIG. 1. The emission spectrum of MgBr in the ultraviolet.

The C–X system as shown in Fig. 1 consists of several groups of single-headed bands degraded to longer wavelengths. The analysis of the system was carried out by the identification of three prominent v''-progressions with $v' = 0$, 1 and 2. The ΔG intervals of the lower state of the system agree very well with the corresponding intervals of the $X^2\Sigma$ state. Thus, almost all the bands in the region λλ 2540–

2720 Å could be attributed to a single system and the band heads could be represented by the following quantum formula:

$$\nu = 39285 \cdot 9 + 271 \cdot 9\,(v' + \tfrac{1}{2}) - 5 \cdot 2\,(v' + \tfrac{1}{2})^2 - 374 \cdot 0\,(v'' + \tfrac{1}{2}) + 1 \cdot 5\,(v'' + \tfrac{1}{2})^2.$$

As the bands are single-headed, the system can be attributed to a $^2\Sigma$-$^2\Sigma$ transition and not a $^2\Pi$-$^2\Sigma$ transition as proposed earlier. The wave number and the classification data are given in Table I. The system appears to be the analogue of the $C^2\Sigma$-$X^2\Sigma$ system of MgF in the region λ 2240-λ 2390 Å and is shifted to longer wavelengths, as expected.

TABLE I

Band head data of the $C^2\Sigma$-$X^2\Sigma$ system of MgBr molecule

Wave number (cm.$^{-1}$)	Intensity	Assignment v', v''	$\nu_{obs.} - \nu_{cal.}$ (cm.$^{-1}$)
39234	3	0, 0	0
39123	3	1, 1	−1·5
39005	1	2, 2	−2·6
38863	3	0, 1	0
38756	5	1, 2	−0·5
38495	2	0, 2	0
38392	10	1, 3	+0·5
38282	6	2, 4	+1·4
38167	1	3, 5	+4·7
38131	3	0, 3	+1·0
38032	7	1, 4	+2·5
37925	6	2, 5	+3·4
37810	3	3, 6	+3·7
37769	7	0, 4	+1·0
37673	7	1, 5	+2·5
37570	6	2, 6	+4·4
37410	6	0, 5	+1·0
37217	5	2, 7	+4·4

One of the authors (Reddy) is thankful to the Council of Scientific and Industrial Research, New Delhi, for the financial support.

Dept. of Physics, B. R. K. REDDY.
Andhra University, P. TIRUVENGANNA RAO.
Waltair, July 23, 1970.

---

1. Olmsted, C. M., *Z. Wiss. Photogr.*, 1906, **4**, 255.
2. Walters, O. H. and Barratt, S., *Proc. Roy. Soc.*, 1928, **118**, 120.
3. Morgan, F., *Phys. Rev.*, 1936, **50**, 603.
4. Patel, M. M. and Patel, P. D., *J. Phys. B (Proc. Phys. Soc.)*, 1969, **2**, 515.
5. Harrington, R. E., *New Band Systems of the Diatomic Earth Halides*, Dissertation, University of California, 1942.

THE HEAVY ATOM EFFECT IN BORIC ACID GLASS FLUORESCEIN (BF) PHOSPHOR

KASHA[1] showed that a heavy atom solvent was as effective as halogen substitution[2,3] in breaking down the spin quantisation in molecules. We have studied the effect of I^- concentration in BF phosphor prepared in the usual way[4] by adding varying amounts of KI but keeping uranin content fixed. It is found that while the total intensity of luminescence falls with I^- concentration, ϕ_p/ϕ_f (the ratio of phosphorescence to fluorescence yield) increases. Side by side, the phosphorescence lifetime decreases, although not proportionately. The effect is absent with Cl^- and is intermediate with Br^-. In Fig. 1, the fluorescence and phosphorescence spectra of a *ca* 10^{-4} gm./gm. fluorescein phosphor with various proportions of KI at 80° K. are given to show how the ϕ_p/ϕ_f ratio changes with I^- concentration. The spectra are scanned with a monochromator photomultiplier arrangement. With excess KI, fluorescence is completely quenched; only phosphorescence remains.

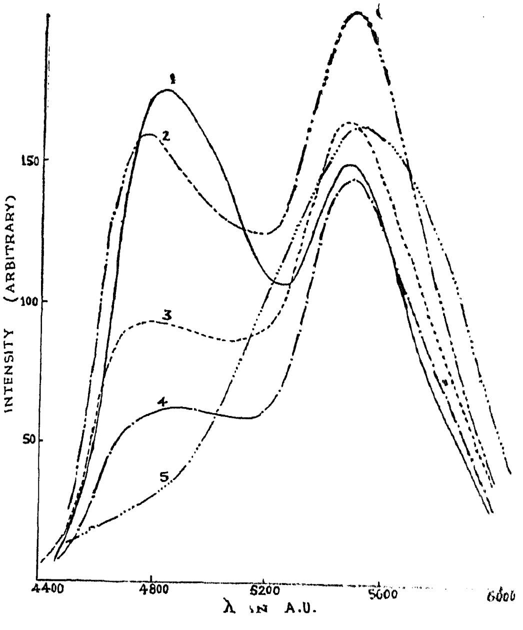


FIG. 1. Luminescence curves (uncorrected) of BF-phosphor at 80° K for (1) KI = 0 gm., (2) KI = 0·5 gm., (3) KI = 0·75 gm., (4) KI = 1·0 gm., and (5) KI in excess. Shorter λ peak: Fluorescence, and Longer λ peak: Phosphorescence.

The kinetics of radiative and non-radiative processes yields the following[5]:

$$K_p = K_{p0} + K_{qp},$$

$$\phi_f = \frac{K_f}{K_f + K_{qf} + K_{IS}}$$

$$\phi_p = \frac{K_{IS}K_{p0}}{(K_{p0} + K_{qp})(K_f + K_{qf} + K_{IS})},$$

and

$$\frac{\phi_p}{\phi_f} = \frac{K_{p0}K_{IS}}{K_f(K_{p0} + K_{qp})} = \frac{K_{IS}}{K_f(1 + K_{qp}/K_{p0})}$$

where K_f = intrinsic fluorescence rate constant ($2 \cdot 2 \times 10^8$ sec.$^{-1}$),[6] K_{qf} = fluorescence quenching rate, K_{IS} = intersystem crossing rate, K_{po} = intrinsic phosphorescence decay rate and K_{qp} = quenching rate for phosphorescence.

The enhancement of ϕ_p/ϕ_f with heavy atom concentration may be due to an increase in K_{IS}, K_{po} and/or K_{qp} as the spin orbit effect due to the heavy atom will increase K_{IS} and K_{po} by singlet triplet mixing and the quenching of the triplet state is also expected. K_f will normally remain unaffected as the oscillator strength of singlet absorption does not change on KI addition. Since with excess KI, ϕ_p/ϕ_f tends to infinity only a large increase in K_{IS} can explain the experimental results. It is, therefore, believed that the effect of heavy atom is in the main to increase K_{IS}. Estimates of K_{IS} for various I^- are given in Table I assuming $K_{p_0} = \cdot 37$ and $K_{qp} = 0$ respectively.

TABLE I

Calculated and experimental values of some rate constants

ϕ_p/ϕ_f	Amount of KI in gm.	τ_p(observed)		$K_{IS} \times 10^{-8}$ for $K_{qp} = 0$	$K_{IS} \times 10^{-8}$ for $K_{qp} = \cdot 37$
		τ_p sec.	K_p sec^{-1}.		
0·84	0	2·7	0·37	1·8	1·8
1·30	0·5	2·5	0·40	2·8	3·0
1·80	0·75	2·25	0·44	3·9	4·7
2·40	1·00	2·00* & 1·75	0·50	5·16	6·9
>15	Excess	..	..	..	..

* Decay curve is non-exponential, taking the longer component of the decay period.

We wish to thank the C.S.I.R., New Delhi, and Atomic Energy Establishment, Trombay, for financial assistance.

D.S.B. Government College,
Dept. of Physics,
Nainital, *August* 7, 1970.

D. D. PANT.
H. C. PANT.*

---

* Present address: Department of Biophysics, Michigan State University, East Lansing, U.S.A.

1. Kasha, M., *J. Chem. Phys.*, 1952, **20**, 71.
2. McClure, D. S., *Ibid.*, 1949, **17**, 905.
3. McGlynn, S. P. and Smith, F. J., *Ibid.*, 1963, **39**, 675.
4. Pringsheim, P., *Fluorescence and Phosphorescence*, Ed. II, Interscience, 1963, p. 435.
5. McGlynn, S. P., Daigre, J. and Smith, F. J., *J. Chem. Phys.*, 1963, **39**, 675.
6. Aristov, A. V. and Sveshnikov, B. Ya., *Opt. and Spectr.*, 1962, **13**, 121.

DISCOVERY AND DUPLICATION OF ANTIBIOTICS : A CORRELATION

IN another note[1] we have reported the fitting of a modified Poisson Distribution to the frequency of duplication of discovery of antibiotics. The present note reports on a linear relation between the number of discoveries and the number of duplications of discovery of antibiotics from micro-organisms over the thirty-year period 1937-66.

The source of data on the report of discovery of antibiotics is a recent compilation by G. S. Rao and others.[2] Table I gives year-wise data on the number of reported discoveries of antibiotics in year t (X_t), the number of new discoveries of antibiotics in year t (Y_t), and the number of duplications in year t (Z_t). In this note the discovery of an antibiotic is considered a duplication if it is identified with another antibiotic and so reported in published documents, irrespective of whether the compounds were produced by one and the same or different species of micro-organisms.

The data given in Table I indicate that X_t, Y_t, and Z_t generally increase with t. A regression analysis was done to examine the relationship between the three variables. Three scatter diagrams were plotted for (X_t, Y_t), (Z_t, Y_t), and (X_t, Z_t) respectively. The diagrams indicated the existence of a linear relation between the respective pairs of variables. To examine this, the following linear relations were assumed:

$$Y_t = \alpha_0 + \beta_0 X_t$$
$$Y_t = \alpha_1 + \beta_1 Z_t$$
$$Z_t = \alpha_2 + \beta_2 Y_t.$$

Least square estimates of the constants α_0, α_1, α_2, β_0, β_1, β_2 were obtained using the data given in Table I.

TABLE I

Year-wise data on reports of discovery, new discovery and duplication

Serial number	Year	X_t	Y_t	Z_t
1	1937	2	1	1
2	38	3	2	1
3	39	8	8	0
4	40	5	2	3
5	41	3	3	0
6	42	15	7	8
7	43	10	6	4
8	44	20	13	7
9	45	25	17	8
10	46	27	25	2
11	47	54	35	19
12	48	44	36	8
13	49	51	35	16
14	50	42	30	12
15	51	53	37	16
16	52	58	46	12
17	53	68	54	14
18	54	84	62	22
19	55	82	60	22
20	56	72	48	24
21	57	119	91	28
22	58	79	57	22
23	59	95	70	25
24	60	89	69	20
25	61	62	45	17
26	62	93	67	26
27	63	107	77	30
28	64	100	80	20
29	65	83	60	23
30	66	77	60	17

$n=30$; $\Sigma X_t=1{,}630$; $\Sigma Y_t=1{,}203$; $\Sigma Z_t=427$

The estimated equations were as follows:

$$Y_t = -0\cdot8075 + 0\cdot7529\,X_t \qquad (1)$$

$$Y_t = 2\cdot084 + 2\cdot6711\,Z_t \qquad (2)$$

$$Z_t = 0\cdot0814 + 0\cdot2671\,Y_t. \qquad (3)$$

Using (1), (2) and (3) the residuals were computed in each case. The following values were obtained:

$$\Sigma\,(Y_t - \hat{Y}_t) = 0\cdot008$$

$$\Sigma\,(Y_t - \hat{Y}_t) = 0\cdot008$$

$$\Sigma\,(Z_t - \hat{Z}_t) = 0\cdot002.$$

This confirmed the fit of a straight line for the linear relation between the pairs of variables concerned.

Analysis of variance was used to test the Null Hypothesis

$$H_{0i} = \beta_1 = 0 \text{ for } 1, 2, 3. \qquad (4)$$

The F values obtained in the ANOVA for (1), (2) and (3) were as follows:

For equation	F	
	Calculated	Expected (1%)[3]
(1)	2,539·26	7·64
(2)	144·96	7·64
(3)	273·75	7·64

Thus, in each of the cases the Null Hypothesis (4) was rejected, indicating a strong relationship between the pairs of variables. The relationship, within the observed range of variation, can be used for prediction of the discovery and duplication of antibiotics.

Documentation Res. and Training Centre,
Indian Statistical Institute,
112 Cross Road 11,
Bangalore-3, India, *July* 6, 1970.

A. NEELAMEGHAN.
V. V. BUCHE.
B. S. S. GUPTA.

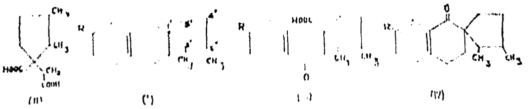
---

1. Neelameghan, A., Buche, V. V. and Gupta, B. S. S., "Distribution pattern of the duplication of discoveries," *Nature*, 1970, **227**, 1060.
2. Rao, G. S., Bannur, B. B. and Purandare, G. M., "Index to antibiotics producing micro-organisms," *Hindustan Antibiotics Bulletin*, August, 1967, **10** (1), 1.
3. Rao, C. R., Mitra, S. K. and Matthai, A., *Formulæ and Tables for Statistical Work*, Calcutta, Statistical Publishing Society, 1966.

SYNTHESIS AND REARRANGEMENT OF DISUBSTITUTED SPIRANES

THE spiranes are known to undergo ring transformation on dehydrogenation with selenium.[1,2] Sengupta and Chatterjee studied the rearrangement of a large number of monosubstituted spiranes of Type I under conditions of catalytic dehydrogenation and observed that they undergo smooth ring transformation giving either phenanthrene or pyrene derivatives depending upon the nature of the alkyl group.[3,4] With a view to study the rearrangement of spiranes with two alkyl substituents in the spirocyclopentane ring, the synthesis of 1, 2, 3, 4-tetrahydronaphthalene-2, 2-spiro-(2′, 3′-dimethylcyclopentane) (I, R = H) and its 7-methyl derivative (I, R = CH_3) have been achieved by an adaptation of the method developed earlier. The starting material for the synthesis was *trans*-2, 3-dimethyl cyclopentanone prepared from ethyl lævulinate by condensation with ethyl magnesium iodide and heating the resulting lactone with polyphosphoric acid followed by catalytic reduction of the cyclopentane derivative by a modification of the method due to Varech.[5] Condensation of this ketone with ethyl cyanoacetate according to Cope's method gave ethyl 2, 3-dimethylcyclopentylidene cyanoacetate, b.p. 123-25° (1·5 mm.) which after KCN addition and hydrolysis furnished 2, 3-dimethylcyclopentane-1-carboxy-1-acetic acid (II), m.p. 160°, anhydride, b.p. 140° (3 mm.), anilic acid, m.p. 175°, anil, m.p. 107°.

The aluminium chloride-catalysed condensation of the anhydride of (II) with benzene gave *αα*-(2, 3-dimethylcyclopentane)-*β*-benzoylpropionic acid (III, R = H), m.p. 107°, 2, 4-DNP derivative, m.p. 218°, which readily formed pyrilium salt. The keto acid on catalytic reduction at 60° under slight pressure yielded *αα*-(2, 3-dimethylcyclopentane)-*γ*-phenylbutyric acid, m.p. 83° which on PPA cyclisation gave 1-keto-1, 2, 3, 4-tetrahydronaphthalene-2, 2-spiro-(2′, 3′-dimethylcyclopentane) (IV, R = H) b.p. 145° (1 mm.), n_D^{30} 1·5508 showing an intense I.R. peak at 5·95 *μ*. Clemmensen reduction of this spiro ketone furnished the desired spirane (I, R = H), b.p. 120-25° (1 mm.), n_D^{30} 1·5500 which on dehydrogenation with 10% Pd-C catalyst at 320° underwent smooth ring transformation without any loss of carbon atom, giving 1, 2-dimethyl phenanthrene, m.p. 142°, sym. T.N.B. complex, m.p. 180°.



(II) (I) (III) (IV)

In a similar manner, the spirane (I, R = CH_3) was prepared from the anhydride of (II) and toluene. The Friedel-Crafts condensation gave *αα*-(2, 3-dimethylcyclopentane)-*β*-(*p*-toluyl)-propionic acid (III, R = CH_3), m.p. 159°, 2, 4-DNP derivative, m.p. 193°. Catalytic reduction of this keto acid gave *αα*-(2, 3-dimethylcyclopentane)-*γ*-*p*-tolylbutyric acid, m.p. 92° which on PPA cyclisation yielded 1-keto-7-methyl-1, 2, 3, 4-tetrahydronaphthalene-2, 2-spiro-(2′, 3′-dimethylcyclopentane) (IV, R = CH_3), b.p. 150-53° (1 mm.), n_D^{25} 1·5505. The spirane (I, R = CH_3), b.p. 120-23° (1 mm.), n_D^{25} 1·5365, obtained by the Clemmensen reduction of the foregoing spiro ketone, underwent smooth rearrangement under conditions of catalytic dehydrogenation furnishing 1, 2, 6-trimethylphenanthrene, m.p. 127-28°, picrate, m.p. 167°, T.N.B. complex, m.p. 183°. The rearrangement has been interpreted as going through a transition state, having a hexahydrophenanthrene skeleton, formed by fission of the $C_{5'}$-$C_{1'}$ bond rather than the more nucleophilic $C_{2'}$-$C_{1'}$ bond due to steric interference, followed by migration to C_1.

Thanks are due to the C.S.I.R. for the award of a Junior Research Fellowship to one of us (S. R. C.) and to Prof. S. C. Shome for laboratory facilities.

Dept. of Chemistry, D. N. CHATTERJEE.
Presidency College, S. R. CHAKRAVORTY.
Calcutta-12, *July* 29, 1970.

---

1. Cook, J. M. and Hewett, C. L., *J. Chem. Soc.*, 1934, p. 365.
2. Sengupta, S. C., *J. Indian Chem. Soc.*, 1940, **17**, 101.
3. — and Chatterjee, D. N., *Ibid.*, 1952, **29**, 438; 1953, **30**, 27; 1954, **31**, 110.
4. Chatterjee, D. N., *J. Am. Chem. Soc.*, 1955, **77**, 414 & 5131.
5. Varech, D. *et al.*, *Bull. Soc. Chim.* (*France*), 1965, p. 1666.

STUDIES ON CALLUS TISSUE OF LEMON FRUIT VESICLE (*CITRUS ACIDA*) CULTIVATED *IN VITRO*

PREVIOUS studies carried out in this laboratory showed that citric acid accumulates in the mature fruit tissues of *Citrus acida* due to excess production of citric acid from carbohydrates and a block in respiration at citrate level and the vesicle may be an active site for citric acid formation.[1,2] Although these studies, carried out on intact fruits, explain the mechanism of formation and accumulation of citric acid, they do not permit an identification of the role of specific nutrients in the production of citric acid. Callus tissues cultivated *in vitro* may be more suitable for carrying out such studies. As the first step in this direction, an attempt was made to obtain a callus tissue from lemon vesicle and use it for nutritional studies.

Lemon fruits of diametrical size 1·4-1·6 cm. obtained fresh from the garden were surface-sterilized by keeping them in 95% alcohol for 20-30 minutes. The fruits were washed with sterile distilled water three times and cut open using sterile scalpel. Green skin, white skin, septa and seeds were removed and intact vesicles were used for the production of callus tissue.

The composition of the medium used for the production of callus is given in Table I. (The same was suggested by Prof. M. K. Subramaniam of Biochemistry Department of Indian Institute of Science, Bangalore.) Twenty ml. of the above medium *minus* IAA which was added later was taken in 50 ml. sugar tubes (20 × 200 mm.) and sterilized by autoclaving at 15 p.s.i. for 10 minutes. IAA was sterilized separately by passing through bactericide filter and added to the tube containing the medium under aseptic conditions. The slants were prepared and the tubes inoculated with 100 mg. of vesicle and incubated at 24° C. ± 2° C. and exposed to light (240 f.c. light). An adequate amount of callus tissue was found to form after eight weeks. The weight of the callus tissue was about 10 times the original weight of the inoculum. There were similar increases in dry weight, protein, citric acid and chlorophyll contents.

The chemical composition of the callus seems to be identical to the composition of vesicle used for the preparation of the callus (Table II).

Next, studies were made on the effects of omitting individual nutrients from the medium on the formation of callus tissues. Data on the effect of omission of different nutrients from the medium on the chemical composition of the callus tissue of lemon vesicles cultivated *in vitro* are given in Table III. The omission of IAA, casein, hydrolysate, glycine or nicotinic acid was found to decrease citric acid content of the callus tissue to 17-62% of control values without affecting the growth.

This suggests that perhaps the callus obtained can be used as a model to study the role of different nutrients in controlling citric acid production.

TABLE I

Composition of the medium used for the production as well as cultivation of callus tissue of citrus fruit vesicle

			Conc./litre
$Ca (NO_3)_2 4H_2O$	..	(E.Merck)	300 mg.
KNO_8	..	(B.D H.)	1000 ,,
KCl	..	(,,)	100 ,,
$MgSO_4 \cdot 7H_2O$	..	(,,)	500 ,,
Na_2SO_4	..	(,,)	200 ,,
$NaH_2 . PO_4$	..	(E.Merck)	100 ,,
NH_4NO_3	..	(B.D.H.)	1000 ,
$MnSO_4$	..	(E. Merck)	10 ,,
$ZnSO_4$	..	(,,)	5·0 ,,
H_3BO_3	..	(B.D.H)	5·0 ,,
KI	..	(,,)	1·0 ,,
Fe EDTA	..	(,,)	1·0 ,,
$Mo O_3$	..	(,,)	0·0017 ,,
$CuSO_4$	..	(,,)	0·013 ,,
Glycine	..	(E.Merck)	0·5 ,,
Nicotinic acid	..	(,,)	0·5 ,,
Thiamine HCl	..	(,,)	0·1 ,,
Pyridoxlne	.	(,,)	0·5 ,,
IAA	..	(Sigma)	10 ,
Kinetin	..	(,,)	1 ,,
Agar	..	(Bacto-Difco)	7 g.
Sucrose	..	(B.D.H.)	28 ..
Casein hydrolysate	..	(Oxoid)	1·0 .,
Coconut milk	..	..	200 ml.

TABLE II

Comparison of the chemical composition of the callus with that of the vesicle

	Dry weight (per cent.)	Per cent dry weight		
		Protein	Citric acid	Chlorophyll
Callus ..	15	21	0·42	2·9
Vesicle ..	17	16	0·31	..

TABLE III

Effect of different nutrients on the chemical composition of the callus of lemon vesicles cultivated* in vitro (Values expressed per flask)

Omission from the medium		Wet weight		Dry weight		Protein†		Citric acid‡		Chlorophyll §	
		(g.)	% of control	(g.)	% of control	(mg.)	% of control	(μg.)	% of control	(mg.)	% of control
None (control)	..	0·95 (0·69–1·1)	100	0·15 (0·07 0·22)	100	32·7 (25·5–36·4)	100	629 (592–680)	100	4·5 (4·0 –5·1)	100
–IAA	..	0·90 (0·75–1·1)	94	0·15 (0·12–0·18)	100	27·3 (23·1–31·9)	83	165 (159-217)	26	2·9 (2·2 –3·3)	64
–Casein hydrolysate	..	0·71 (0·61 0·85)	75	0·13 (0·11–0·16)	87	25·2 (20·3–29·3)	77	105 (94–121)	17	1·3 (1·0 –1·5)	29
–Glycine	..	1·03 (0·87–1·20)	108	0·16 (0·13–0·17)	107	22·9 (19·1–25·7)	70	178 (147–210)	28	1·1 (0·7–1·5)	24
–Nicotinic acid	..	1·01 (0·86–1·25)	106	0·19 (0·12–0·22)	126	32·3 (28·5–36·2)	98	395 (273–424)	62	1·6 (1·3 –1·8)	36

* 100 mg. wet weight of callus tissue was cultivated for 8 weeks at 24 ± 2° C. The callus tissue used for cultivation contained 10 mg. dry weight, 3·5 mg. protein, 0·3 mg. chlorophyll and 73 μg. citric acid. † Protein content was estimated by microkjeldahl method. ‡ Estimated by the method of Natelson *et al.* (1948). § Estimated by the method of Richards (1952),

Dept. of Biochemistry, L. J. PAREKH.
Baroda University, D. A. MEHTA.
Baroda, India, August 7, 1970.

---

1. Ramakrishnan, C. V. and Varma, T. N. S., *Mem. Ind. Bot. Soc.*, 1959, **2**, 79
2. Parekh, L. J. and Shah, V. J., *Enzymologia* (In press).
3. Natelson, S., Puncus J. B. and Lugovoy, J. K., *J. Biol. Chem.*, 1948, **175**, 745.
4. Richards, F. A., *Jour. Mu. Res.*, 1952, **11**, 156.

EFFECT OF WATER SATURATION ON LONGITUDINAL WAVE VELOCITIES IN ROCKS

A STUDY of longitudinal wave velocities in dry and water-saturated samples of different varieties of rocks obtained from important geological formations in India has been carried out at normal temperatures and pressures using direct pulse transmission techniques.[1] The rock core samples were saturated under complete vacuum to obtain 100% water saturation.

TABLE I

Longitudinal wave velocities in dry and water-saturated samples

Sample No.	Rock type, geological horizon and number of samples studied		Average density	Average porosity %	Velocities in dry specimens km./sec.	Velocities in water saturated specimens km./sec.
1	Tirupati sandstones (A.P.) (6)	..	2·74	40·39	2·35	2·10
2	Rajahmundry sandstones (A.P.) (9)	..	2·51	26·44	4·43	4·24
3	Lower Gondwana sandstones (M.P.) (6)	..	2·40	36·44	3·11	2·87
4	Cuddapah sandstones (A.P.) (6)	..	2·80	8·13	5·37	5·40
5	Kymore limestones (Vindhyan) (M.P.) (8)	..	2·72	3·116	6·53	6·44
6	Amarkantak basalt (M.P.) (6)	..	2·78	27·40	4·36	4·08
7	Serpentinities (Bhimatnagar–Orissa) (6)	..	2·76	8·54	4·99	4·85
8	Marble–Bhedaghat (Jubbalpore, M.P.) (4)	..	2·81	Negligible, less than 0·5%	6·23	6·93
9	Grey granite (Hyderabad, A.P.) (4)	..	2·62	,,	5·62	5·96
10	Dunites (Sukrangi, Orissa) (2)	..	3·24	,,	7·22	7·29

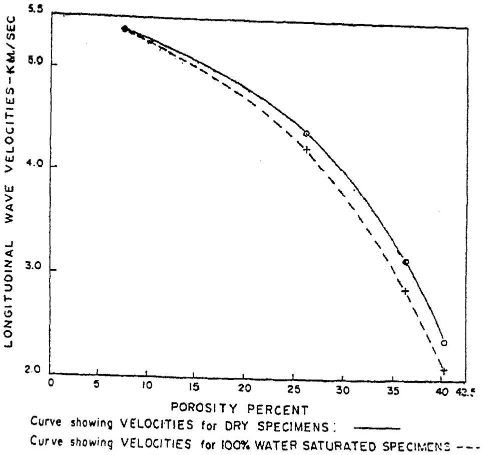


FIG. 1. Showing effect of water saturation on longitudinal wave velocities in sandstones at N.T.P.

Table I represents the results obtained during the studies with different rocks. Figure 1 exhibits the fact that rocks with higher porosities show an appreciable decrease in velocities after water saturation. Compact crystalline rocks like granites, marbles, are found to show a totally different behaviour as compared to the porous rocks and indicate increase in longitudinal wave velocities of the order of 11% when they are saturated with water. These rocks generally show porosities lower than 1% and in such rocks, the porosity is known to be mostly crack porosity and not an intergranular porosity as in sedimentary rocks.

Recent observations made by Dortmen and Magid,[2] who also observed increase in longitudinal wave velocities in pyroxenites, dunites and granites after water saturation, also indicate that the elastic behaviour of water-saturated crystalline rocks with negligible porosity is different from that of porous rocks at normal temperatures and pressures.

The author is grateful to Dr. S. Balakrishna, Assistant Director, for some useful suggestions, and to Dr. Hari Narain, Director, for permission to publish this note.

Rock Mechanics Division, B. S. GOGTE.
National Geophysical Res. Inst.,
Hyderabad-7, *July* 24, 1970.

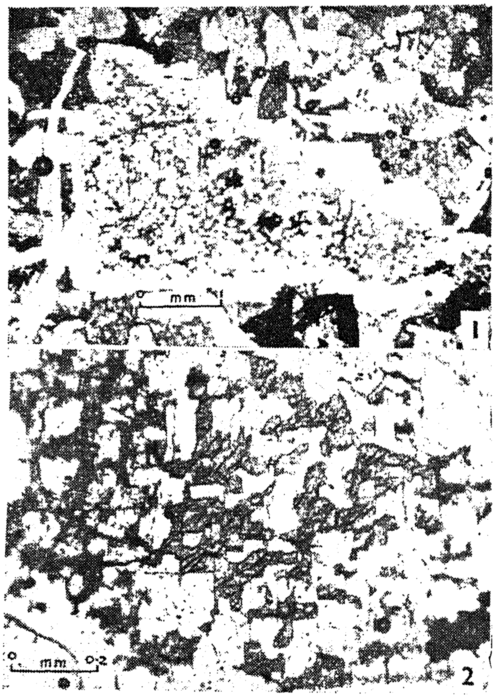
---

1. Balakrishna, S., *Bull. (IZY) Acad. Sci. USSR, Geophys. Ser.*, 1969, Nos. 3 and 5.
2. Dortmen, N. B. and Magid, M., *Docklady of the Academy of Science, USSR*, March–April, 1968, **179**, 1.

PLAGIOCLASE TECOBLASTS IN DOLERITE DYKES OF PACHMARHI AREA, MADHYA PRADESH

PLAGIOCLASE phenocrysts, representing the early phase of crystallisation of a slowly cooling magma, are of common occurrence in basaltic rocks. On the other hand, tecoblasts (late phase crystals developed at the expense of the groundmass)[1] are comparatively rare and have not been reported from the Deccan basalts or associated dolerites. The occurrence of plagioclase tecoblasts was first observed by the writers in a dolerite dyke intrusive into Gondwana sandstones at Mount Dhupgarh, six miles to the west of Pachmarhi (Lat. 22° 29′ N; Long. 78° 26′ E) in Hoshangabad District, Madhya Pradesh. Subsequently, they were noted in samples from Mutkuli, 17 miles from Pachmarhi on the Pipariya Road. In both the areas basalts occur within two miles of the dykes.[2]

The plagioclase tecoblasts are relatively uncommon and are of irregular to subhedral form. They contain inclusions of pyroxenes and iron oxides (Fig. 1). In a few instances, a basaltic mesostasis is also present. Ideally, subhedral pyroxene inclusions show linear arrangement within the plagioclase crystal giving rise to an apparent intergrowth of the two minerals (Fig. 2). However, the continuity, in adjacent pyroxenes, of features like cleavage and the presence of other groundmass constituents are clear indications of a relict origin. Moreover, in most tecoblasts the pyroxene inclusions are irregular to even shred-like in form. The early phase of tecoblast development is manifested by the growth of plagioclase laths across pyroxene crystals or by inclusion trails within plagioclase leading to pyroxene crystals at the margin. Rarely the almost completely assimilated groundmass is represented by 'pigment rests'. Thus, all stages of tecoblast growth are documented and this leads to the conclusion that the larger plagioclase crystals have developed during a later phase as a result of the corrosion and assimilation of the groundmass. The irregular shape of plagioclase crystals points towards growth under restricted conditions.



FIGS. 1-2. Fig. 1. Plagioclase tecoblast of irregular in shape, dolerite containing inclusions of pyroxenes and iron oxides. Fig. 2. Magnified view of part of the same tecoblast showing relationship between host plagioclase and pyroxene inclusions

Preliminary study indicates that there is no definite relationship between the anorthite content of tecoblast and groundmass plagioclase, probably because of the varying nature and amount of the material assimilated. However, the tecoblasts plot in anomalous positions with reference to the plutonic and volcanic curves of Slemmons[3] who regards this as being due to unusual crystallisation history or chemical composition.

Dept. of Geology,
University of Poona,
Fergusson College Campus,
Poona, *July* 22, 1970.

K. B. POWAR.
G. G. DESHPANDE.

---

1. Augustithis, S. S., *Inst. Petrogenesis & Geochemistry Spec. Bull.* honouring *Prof. Drescher-Kaden*, 1964, p. 15.
2. Crookshank, H., *Mem. Geol. Surv. India*, 1931, **66**, 173.
3. Slemmons, D. B., *Geol. Soc. Amer.*, Sp. Paper, 1962, p. 64.

A NOTE ON THE RED CELL ACID PHOSPHATASE VARIANTS ON CHRISTIAN GIRLS FROM KERALA

HOPKINSON *et al.* (1963) had earlier described a new human polymorphism involving differences in the acid phosphatase which occurs in red cells. There is, however, one feature of the red cell acid phosphatase system which is of some general interest and is perhaps worthy of brief comment. In this system one may distinguish electrophoretically six distinct phenotypes (A, B, BA, C, CA and CB) which have been shown to be determined by three common alleles. Each phenotype shows more than one electrophoretically distinct isoenzyme component, and the phenotypes differ from one another in the relative mobilities and the relative intensities of these components. It would, therefore, be interesting to find the answer pertaining to the above: whether the enzyme polymorphisms that do occur are usually a matter of quantitative differences in rates of synthesis or whether qualitative differences in enzyme structure are a common feature.

So far some twelve arbitrarily chosen enzymes have been examined in various degrees of detail and the red cell acid phosphatase seems to have been found to exhibit striking polymorphism as will be evident from the studies by Hopkinson *et al.* (1964); Giblett *et al.* (1965) and Fuhrmann *et al.* (1966) on English, African and German populations respectively.

To examine the relative frequency and the nature of polymorphic variants on Indian population groups, the data for which is yet to be collected and described electrophoretically, a study on the RBC acid phosphatase on 50 Christian girls from Kerala, then residing in Tübingen, Heidelberg and München in West Germany, was conducted in the laboratory of Institute for Anthropology and Human Genetics, Heidelberg, during April-August 1967. Of the total subjects examined, 23 girls came from Aleppy District while the rest were from Kottayam District of the State. They were all unrelated and went as trainees in nursing profession.

The electrophoretic method was followed after Hopkinson *et al.* (1963) with a slight modification. The red cell hemolysates were subjected to electrophoresis in starch gel at pH 6·0 under high voltage and after electrophoresis the gel was stained specifically for the enzyme in study. Red cells were washed three times in 0·9% NaCl, centrifuging for five minutes at 300 r.p.m. Hemolysates were prepared by the addition of two volumes of distilled water to one volume of washed packed red cells. The hydrolysed starch was available from Cannaught Laboratory (U.S.A.). The gel was made using succinic acid/tris buffer (0·0025 m. in succinic acid with 0·0046 m. in tris at pH 6·0). A citric acid/NaOH buffer (0·41 m. in citric acid at pH 6·0) was used as a bridge solution. The dimension of the gel was 19 cm. × 8 cm. × 0·7 cm. (thick) and Whatman No. 17 filter-paper was used. It has also been possible to show that the red cells of the phenotypes differ in levels of total acid phosphatase activity.

In our study, the individuals of the homozygous type B shows about 60% greater activity than individuals of homozygous type A. The heterozygous type BA is intermediate in this respect. The presence of a rare heterozygous variant CB even in this small sample is exciting.

TABLE I

Frequencies of RBC acid phosphatase phenotypes on fifty Christian girls from Kerala

RBC acid phosphatase phenotypes	No. of individuals	Incidence
A	1	0·02
B	30	0·60
BA	18	0·36
CB	1	0·02

On the basis of the studies on English population Hopkinson *et al.* (1964) observed that the types BA and B comprise more than 80% while the other types were relatively rare. The Tristan Islanders also present high B while no CA and CB were found. The high incidence of CA and CB and homozygous C was apparent from the study of Giblett and Scott (1966). The Germans from Heidelberg also show high B as compared to other types. The high frequency of types B and BA and the presence of a rare variant CB characterises the population studied, which poses a variety of problems both in biochemistry and genetics. The electrophoretic techniques facilitate mass screening for enzyme variants and the study of enzyme variants is a great promise for the study of population genetics in India.

Reader in Physical Anthropology,
Andhra University,
July 10, 1970.

M. R. CHAKRAVARTTI.

---

1. Fuhrmann, W. and Lichta, H. H., "Human red cell acid phosphatase polymorphism—A study on gene frequency and Forensic use of system in cases of disputed paternity," *Humangenetik*, **1966, 3,** 121.
2. Giblett, E. R. and Scott, N. M., "Red cell acid phosphatase: racial distribution and report of a new phenotype," *Am. J. Hum. Genet.*, **1965, 17,** 425.
3. Hopkinson, D. A., Spencer, N. and Harris, H., "Red cell acid phosphatase variants: a new human polymorphism," *Nature* **1963, 199,** 969.
4. —, — and —, "Genetical studies on human red cell acid phosphatase," *Am. J. Hum. Genet.*, **1964, 16,** 141.

STUDIES ON THE DEVELOPMENT OF LOW NEUROTOXIN (B-N-OXALYL AMINO ALANINE) LINES IN *LATHYRUS SATIVUS* (KHESARI)

RECENTLY[1,2] B-N-oxalyl amino alanine (BOAA) has been found to be present in *L. sativus* seeds. According to Bell,[3] BOAA is most probably the principle responsible for neurolathyrism in man. This gives a new approach for the eradication of lathyrism (*see* also Mohan *et al.*[4]), *viz.*, the development of varieties of lathyrus which are inherently low or completely free of their BOAA content, through plant breeding methods of selection, hybridization and mutation.

In the present investigations, a large collection of *L. sativus* germplasm maintained in the Institute, was screened for its BOAA content by a paper chromatographic method standardised in this laboratory. As a result of screening over 1,500 samples, a few cultures having a low neurotoxin content (BOAA) which varied from 0·15 to 0·3% were isolated. From these cultures further single plant selections were followed in the succeeding generation to find out the range of variability of the BOAA content in these samples and to further select strains which may show still lower neurotoxin levels or be completely free from it. In Table I are presented the neurotoxin levels and yield data of some lathyrus lines which appear quite promising.

TABLE I

The BOAA content and yield data of some promising low neurotoxin lines in L. sativus

Name of the selection/ variety	Yield Kg / hectare	Neurotoxin content (BOAA) %
L.S. 10	698·5	0·19
L.S. 17	542·8	0·18
L.S. 248	618·5	0·17
L.S. 288	657·2	0·23
L.S. 390	521·5	0·28
L.S. 105	416·3	0·27
Control checks:		
T_2-12 (Gujarat)	418·6	1·28
LC-76 (Bihar)	588·3	1·65
Rewa-2 (M.P.)	598·2	1·85

From these data it is apparent that the neurotoxin (BOAA) content of the selections is much lower than some of the commercially grown strains, consumption of which leads to the development of lathyritic symptoms in population groups. Further, it is interesting to note that the yield potential of some of the low neurotoxin strains is quite comparable to and, in cases, even greater than the commercial types.

The results reported here appear to be highly encouraging towards the development of low neurotoxin strains for overcoming the problem of lathyrism.

Our thanks are due to Dr. M. S. Swaminathan, Director of the Institute, and Dr. H. K. Jain, Head, Division of Genetics, for their interest and encouragement.

Division of Genetics,
Ind. Agric. Res. Inst.,
New Delhi-12,
August 5, 1970.

L. M. JESWANI.
B. M. LAL.
SHIV PRAKASH.

---

1. Murti, V. V. S., Seshadri, T. R. and Venkitasubramaniam, T. A. V., *Phytochem.*, 1964, **3**, 73.
2. Rao, S. L. N., Adiga, P. R. and Sarma, P. S., *Biochem.*, 1964, **3**, 432.
3. Bell, E. A., *Nature*, 1964, **203**, 378.
4. Mohan, V. S., Nagarajan. V. and Gopalan, C., *Ind. J. Med. Res.*, 1966, **54**, 410.

IMMUNOLOGICAL STUDIES ON EMBRYONIC CHICK CARTILAGE

THE present work was undertaken to study the immunological differentiation of embryonic chick cartilage by means of fluorochrome-labelled antibody. For the above study it was considered more desirable to use an antibody produced against embryonic rather than adult cartilage. Several workers[1-3] reported a failure to produce an antibody against acid mucopolysaccharides of cartilage. Antibodies against the light fraction of protein-polysaccharides extracted from cartilages of young (pre-adult) mammals have, however, been produced.[4-6] Of these, only Hirschman and Dziewiatkowski[5] coupled the antibody to fluorescein isothiocyanate to use it in histological preparations to detect the relative amounts of protein-polysaccharides in various areas of calcifying cartilage.

The antigen was prepared from limb cartilages of 12-day-old chick embryos. The cartilage was cleaned of all surrounding tissues and central ossifying area of diaphysis, while kept immersed in physiological saline. The cleaned cartilage was ground in a mortar and homogenised in a glass homogeniser, in saline medium. The resultant liquid was centrifuged and only the supernatant, containing saline-soluble components of the cartilage, was used in the experiments. It was concentrated by filtration through G 25 coarse Sephadex until the amount of antigenic solids in the solution was in the range of 5 to 15 mg./ml. (estimated with the help of a refractometer).

The first two injections of the antigen in rabbits were subcutaneous and consisted of a mixture of the antigen and Freund's adjuvant (a ratio of 1 : 3). Subsequent injections were given in the marginal ear vein and were without the adjuvant. A total of approximately 138 mg. of the antigen was injected in a period of three months. Precipitin ring tests, according to the methods of Kabat and Mayer,[7] were performed thrice; twice during the period of the experiment and once at the end. The last precipitin tests gave positive results only up to an antigenic concentration of 0·15 mg./ml. This suggests that the saline-soluble components of the embryonic chick cartilage are very weakly antigenic.

For fluorescent antibody work, the technique used was largely that recommended by Nairn.[8] Lissamine Rhodamine B (RB 200, from C. T. Gurr) was converted to its sulphonyl chloride. Conjugation of the fluorochrome with the antibody was carried out after separating the globulin from the whole serum by means of precipitation with ammonium sulphate (50% saturation). The globulin solution was mixed with twice the volume of carbonate-bicarbonate buffer (pH 9·0; M 0·5) and stirred thoroughly at 0-4° C., while the solution of fluorochrome (0·1 ml. of fluorochrome : 1·0 ml. of globulin) was slowly added over a period of 15 minutes; stirring continued for another half hour. The fluorochrome-antibody complex was separated from any uncoupled fluorochrome by passing it through a Sephadex G 25 column, and was brought to its original volume by dialysing against polyhydroxyl alcohol.

Ten-day-old chick embryos were used to test the fluorochrome-labelled antibody. The embryos were snap frozen by dropping in liquid nitrogen for five minutes and after freeze substitution by the usual procedure were embedded in 54° C. paraffin wax. The hydrated sections of the embryos containing fully formed cartilage were allowed to react with the fluorochrome-labelled antibody for 105 minutes at room temperature, in humid atmosphere. The sections were washed in several changes of saline, mounted in buffered glycerol and viewed under Reichert Zetopan microscope with an Osram HBO 200 mercury lamp to provide UV illumination. Control sections were allowed to react with fluorochrome-labelled normal serum.

The results indicate a fluoroscence only in the peripheral region of the cartilage, but no fluorescence in the cartilage matrix in the centre. This suggests that there is a higher concentration of cartilage specific macromolecules in the perichondrial region of the cartilage. From this it may also be inferred that immunological differentiation follows rather than precedes the histological differentiation in the case of embryonic chick cartilage.

The authors thank Professor C. H. Waddington, F.R.S., for encouragement and providing facilities in his laboratory and to Mrs. R. Clayton for introducing one of us (S. C. G.) to immunological techniques.

Institute of Animal
Genetics,
West Mains Road,
Edinburgh EH 9 3 JN, *July* 23, 1970.

Suresh C. Goel.*
A. Jurand.

---

* Present address: Department of Zoology, University of Rajasthan, Jaipur-4, India.

1. Boake, W. C. and Muir, H., *Lancet*, *1955-II*, 1955, p. 1222.
2. Humphrey, J. H., *Biochem. J.*, **1943**, **37**, 460.
3. Quin, R. W. and Cerroni, R., *Proc. Soc. Exp. Biol. Med.*, 1957, **96**, 268.
4. Di Ferrante, N., *Science, N.Y.*, **1964**, **143**, 250.
5. Hirschman, A. and Dziewiatkowski, D. D., *Ibid.*, 1966, **154**, 393.
6. Loewi, G. and Muir, H., *Immunology*, **1965**, **9**, 119.
7. Kabat, E. A. and Mayer, M. M., *Experimental Immunochemistry*, Thomas, Springfield, Illinois, 1964.
8. Nairn, R. C., *Fluorescent Protein Tracing*, Livingstone, Edinburgh, 1962.

A NEW SPECIES OF THE GENUS *IDRIELLA**

During the course of studies on mycoflora on leaf litter, a fungus producing spores closely similar in ontogeny and morphology to that of *Idriella lunata* Nelson and Wilhelm,[1] but differing from it in having septate conidia and conidiophores was obtained. A description of the fungus is given below.

The fungus occurs as a saprophyte on both surfaces of leaves and the characteristic spore clusters give the colonies a shining appearance under the stereoscopic microscope. The mycelium is superficial, hyaline to subhyaline, and composed of septate, branched hyphæ 2-3 μ wide. The conidiophores arise laterally from the cells of the vegetative hyphæ and are erect. The young conidiophores are subhyaline with one or two septa, wider at the base, tapering gradually above and bearing a cluster of conidia towards the apex (Fig. 1). The mature conidiophores are dark-brown at the basal portion, 2-5-septate, the wall at the apex being subhyaline and thin. The conidiophores show considerable variation in length (21–144 μ). The conidia are produced in heads (Fig. 2 A). They are hyaline, two-celled and lunate with acuminate tips (Fig. 2, B). They remain in place until a head composed of 6-8 conidia has been formed. The conidia measured 13–23 × 2–3 μ. After the conidia are shed, the conidiophore tip bears distinct conidial scars and appears somewhat geniculate (Fig. 2, C). Forking of the conidiophore was noticed in one or two cases (Fig. 2, D).

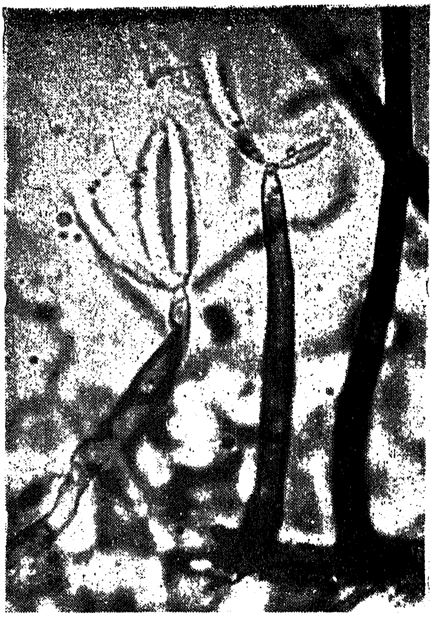


FIG. 1. Photograph showing the conidiophores bearing mature and developing young conidia on the leaf surface (× 110).

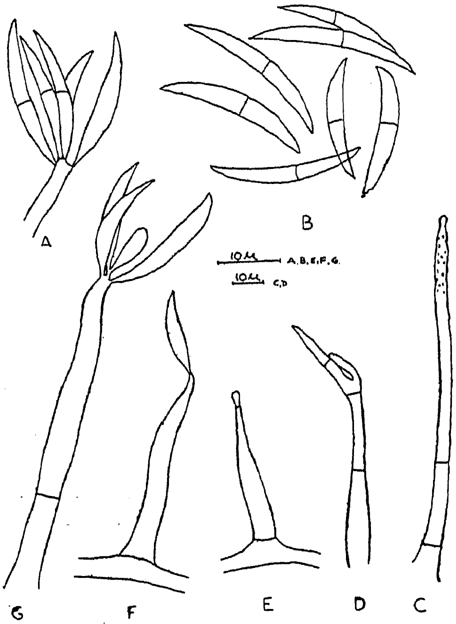


FIG. 2. A, Terminal portion of a mature conidiophore showing head of conidia; B, Conidia; C, Conidiophore showing conidial scars; D, Forked conidiophore; E, F, G, Conidial development.

The conidia appear to be blastospores and begin development as small swellings at the tip of the conidiophore (Fig. 2, E) and develop one at a time (Fig. 2, F). As new conidia form on the elongating conidiophores, the mature conidia come to occupy a lateral position (Fig. 2, G).

The fungus is best classified in the genus *Idriella*. However, the present fungus differs from *Idriella lunata* Nelson and Wilhelm, the type and the only species so far known, in having septate conidiophores and 1-septate conidia (in *I. lunata* both the conidiophores and conidia are non-septate). The fungus is therefore classified as a new species of *Idriella*.

The genus has not so far been recorded from India.

Idriella vandalurensis SP. NOV.

Mycelium superficial, hyaline to subhyaline, septate, branched, 2–3 μ wide. Conidiophores simple, erect, subhyaline to brown, 1–5-septate, variable in length, 21–144 μ. Conidia produced on sympodulæ, blastospores, hyaline, smooth, lunate, two-celled, 13–23 × 2–3 μ.

Type.—Collected on dead leaves of *Capparis* in litter, Vandalur near Madras. Coll. B. P. R. Vittal, 18th March 1970. Deposited in the Herb. MUBL No. 2151.

Idriella vandalurensis SP. NOV.

Mycelium superficialia, hyalinum vel subhyalinum, septatum, ramosum, 2–3 μ latitudinis. Conidiophori simplices, erecti, subhyalini vel rubri, 1-5-septatis, longitudinis variabilis 21-144 μ. Conidia producta in sympodulis, blastosporæ, hyalinæ, lunatæ, leves, bicellulares, 13–23 × 2–3 μ.

Typus.—Collectus, in foliis mortuis *Capparis* in recremento Vandalur prope Madras. a B. P. R. Vittal, March 18, 1970, et, depositus, in Herbario MUBL No. 2151.

I am very grateful to Prof C. V. Subramanian for guidance, and to Rev. Fr. T. N. Siquiera for correcting the Latin diagnosis.

Centre for Advanced Studies in Botany,
University Botany Lab.,
Madras-5, India, *July* 27, 1970.
B. P. R. Vittal.

---

* Memoir No. 88 from the Centre for Advanced Studies in Botany.

1. Nelson, P. E. and Wilhelm, S., *Mycologia*, 1956, **48**, 547.

ENVIRONMENTAL MODIFICATION OF SEX EXPRESSION IN SUGARCANE*

Occurrence of genetically mediated pistillody has been reported in sugarcane by several workers.[1-3] This note reports an instance of environment-induced pistillody in a parthenogenetic derivative (P′1036/1) of the hybrid cane variety, Co. 602. The parent, a notable breeding stock, flowers freely during mid-October. The spikelets are normal except for non-dehiscent anthers. Flowering in P′1036/1 commences from early September and extends into late October. The condition of the floral parts was however found to vary with season and hence periodical observations were made on sex expression in the genotype.

Table I

Condition of the spikelet, percentage abnormalities at different periods of flowering season in P′1036/1 and mean day length

Sl. No.	Sampling occasion		Morphological condition of the spikelets	Per cent abnormal spikelets	Mean day length	
					Hours	Minutes
1	September 2nd week	..	Anthers fully modified into pistils	91·62±8·35	12	17
2	September 3rd week	..	,,	83·67±6·12	12	13
3	September 4th week	..	(i) Anthers fully modified into pistils (ii) Anthers partially modified into pistil-like structures	68·69±4·37	12	01
4	October 1st week	..	Anthers partially modified into pistil-like structures	47·23±5·32	11	54
5	October 2nd week	..	,,	19·51±4·16	11	48
6	October 3rd week	..	,,	6·73±3·64	11	43

Weekly observations were made covering the entire span of tasseling. For each observation, five fully emerged inflorescences were included. Hundred spikelets drawn at random from the middle portion of each of the five inflorescences were scored for abnormalities. Observations on sex expression and percentage occurrence of abnormalities on spikelet basis together with their standard errors are presented in Table I.

The occasions significantly differed from one another except for periods 1 and 2. The data indicate a progressive decline in the frequency of pistillody from mid-September onwards, the last occasion yielding only 6·73% of abnormal spikelets.

Sex expression in plants has been studied largely from the genetic point of view.[4] The phenomenon is however known to be modified by environmental and chemical means.[5,6] Day length has been shown to be a major factor controlling flowering in sugarcane, long days delaying and short days hastening flowering.[7] Apart from its inhibitory effect on transmission, long-day regimen was found to induce pistillody and in a few extreme cases leaf-like structures in an early flowering hybrid sugarcane clone, K. 366.[8]

The parallel between recovery towards normal sex condition and fall in day length observed in the present case is suggestive. It appears probable that sex expression in the genotype, P′1036/1 is, at least in part, controlled by photoperiod.

Sugarcane Breeding Inst., R. Narasimhan.
Coimbatore-7, *June* 29, 1970. B. V. Natarajan.

* Published with the kind permission of the Director, Sugarcane Breeding Institute, Coimbatore-7.

1. Dutt, N. L. and Rao, J. T., *Curr. Sci.*, **1948**, **17**, **241**.
2. Krishnaswami, M. K., *Proc. All-India Conf. Sug. Res. & Dev. Workers*, Coimbatore, 1951, **1**, 20.
3. Raghavan, T. S., *Curr. Sci.*, **1951**, **20**, **138**.
4. Westergaard, M., *Adv. Genetics*, **1958**, **9**, **217**.
5. Heslop-Harrison, J. and Heslop-Harrison, Y., *Nature*, London, **1958 *a***, **181**, **100**.
6. — and —, *Port. Acta Biol.*, Ser. A, **1958 *b***, **5**, **79**.
7. Vijayasaradhy, M. and Narasimhan, R., *Proc. int. Soc. Sugarcane Tech.*, **1953**, **8**, **371**.
8. —, Personal communication, **1961**.

GENUS *TRIBONEMA* IN INDIA

THE Xanthophyceæ are a scarce group in India and so far only seven genera comprising 28 species (including *Vaucheria* spp.) are known to occur in this country.[1-7] The genus *Tribonema* is reported in literature as two forms of a single species which were described as *Tribonema bombycinum* (AG) Derbes *et* Solier f. *minor* (Wille) West and *T. bombycinum* f. *tenuis* Hazen.[1] These two forms, along with the parent species *T. bombycinum*, are now considered to belong to *T. vulgare* Pascher with which species they have been merged.[2] It would thus appear that the forms recorded from India are no longer recognized and the only species deemed to occur within the country is *T. vulgare* Pascher.[2]

In the course of excursions in the Himalayan and sub-Himalayan regions, one of the authors (RKM) collected several samples of *Tribonema* from Kulu Valley (October 1967) and Kashmir Valley (October 1968). The Kashmir material was subsequently identified as *T. vulgare* Pascher,[2] a plant already known to occur in India but very inadequately described. The Kulu plant was found to be *T. ulotrichoides* Pascher[2] —an alga hitherto unknown from India. It is intended to record and describe both the Indian plants briefly here.

Tribonema vulgare PASCHER (Figs. 1 & 2)

Filaments bright yellowish-green in colour. Cells about 2-3 times as long as broad. Chromatophores irregular, discoid, very often as half girdles, one or two chromatophores in young cells which later on divide and become numerous discoid pieces in each mature cell (Figs. 1 and 2). Swarmers and akinetes were not present. Cell-walls composed of H-pieces with ends of filaments mostly open.

Cells 14-26 μ long, 8-9 μ broad with 1-10 chromatophores without pyrenoids and with a single nucleus.

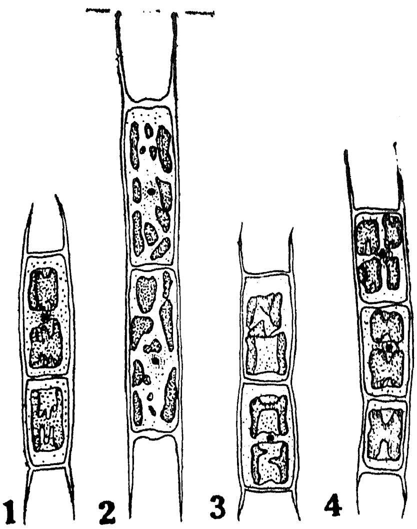
Habitat.—In a small rivulet at Pahalgam, Kashmir Valley. Altitude about 8,000 ft. (Coll. No. K-15).

Tribonema ulotrichoides PASCHER (Figs. 3 & 4) *forma*

Filaments yellowish-green in colour. Cells 2-3 times as long as broad. Chromatophores initially single, of ulotrichalean type, in parietal girdles when young, fragmenting later into two or more (upto four), without pyrenoids. Nucleus single in each cell. Cell-walls composed of H-pieces (Figs. 3 and 4). Swarmers and akinetes not seen,

Cells 16·5-40·5 μ long, 8-12 (-16) μ broad.

Habitat.—Attached to pebbles in slow streams at Rahla, Kulu Valley. Altitude about 8,000 ft. (Coll. Nos. 212, 213 and 222)



FIGS. 1-4. Figs. 1-2. *Tribonema vulgare* Pascher showing vegetative filaments and cell morphology. Fig. 1. Young cell showing one or two chromatophores. Fig. 2. Mature cells containing numerous discoid chromatophores and a single nucleus each. Figs. 3-4. *Tribonema ulotrichoides* Pascher. Cells containing one, two or four chromatophores within them. The ends of the filaments are 'open, showing the 'H'-pieces in the cell-wall (All, × 780).

This form closely resembles *T. ulotrichoides* Pascher in morphology but slightly differs in length and breadth. The cells of the Indian plant are somewhat broader and longer than those of the type species.

This species is being recorded for the first time from India.

Dept. of Botany, BRAJ NANDAN PRASAD.
Lucknow University, R. K. MEHROTRA.
Lucknow, *August* 4, 1970.

---

1. Biswas, K., *Rec. Bot. Surv. of India*, **1949**, **15**, 1.
2. Pascher, A., "Heterokonten," in *Rabenhorst's Kryptogamen-Flora*, Akademische Verlagsgesellschaft, M.B.H., **1939**.
3. Prasad, B. N. and Srivastava, P. N., "*Heterothrix ulotrichoides* Pascher in India," *Curr. Sci.*, **1963**, **32** (6), 272.
4. — and —, *Botrydiopsis arrhiza* Borzi in India," *Ibid.*, **1964**, **33** (19), 596.
5. Patel, R. J. and Francis, M. A., "Observation on *Vaucheria longicaulis* Hoppangh from India," *Phykos*, **1968**, **7**, 98.
6. Srinivasan, K., "Algarum species ex India oruindae," *Bull. Bot. Survey of Inaia*, **7** (1-4), 188.
7. Venkataraman, G. S., *Vaucheriaceae*. I.C.A.R., New Delhi, **1961**.

REVIEWS AND NOTICES OF BOOKS

A Profile of Mathematical Logic. By Howard DeLong. (Addison-Wesley Publishing Company, Inc., West End House, 11 Hills Place, London, W. 1, England), 1970. Pp. xiv + 304. Price 103 *sh.*

The general aim of this book is to describe mathematical logic; its historical background, its nature, and its philosophical implications. It is meant to appeal to anyone—students, mathematicians, linguists, computer specialists, philosophers, etc.—who would like a relatively brief and readable introduction. The book presupposes no knowledge of logic and only high school mathematics. The emphasis throughout is on understanding, not technique. The focus is on topics not presently suitable for mechanical techniques of learning; among these topics are the historical reasons why Aristotelian logic came into being, how it came about that after more than 2,000 years traditional logic gave way to mathematical logic, the nature of the formal axiomatic method and the reasons for its use, the main results of metatheory, and the philosophic import of those results. The treatment of the Gödel metatheorems is especially detailed and clear. The book also features an extensive annotated bibliography which may be used to introduce a student to the literature on the subject.

C. V. R.

Fundamentals of Geometry. By Bruce E. Meserve and Joseph A. Izzo. (Addison-Wesley Publishing Company, Inc., West End House, 11 Hills Place, London, W. 1, England), 1969. Pp. vii + 246. Price 93 *sh.*

This book is aimed at prospective teachers in training for secondary schools and colleges, and all those wishing a broad understanding of mathematics. Emphasizing basic concepts, the text covers the development of Euclidean geometry from projective and affine geometries, with a substantial introduction of the elements of Euclidean geometry, the non-Euclidean geometries, finite geometries, and topology. The primary purpose of the book is to help the student discover how Euclidean plane geometry is related to, and often a special case of, many other geometries. There is ample material for a one or two semester course depending on the student.

C. V. R.

Applied Spectroscopy Reviews, Vol. 3. Edited by Edward G. Brame, Jr. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1970. Pp. xii + 345. Price $ 17.50/£ 8 7 *sh.* 0 *d.*

This series provides the latest information on principles, methods, and applications of spectroscopy for the researcher, with discussions that relate physical concepts to chemical applications. Written by noted spectroscopists, the articles cover the field of spectroscopy, so that chemists, physicists, biochemists, and other scientists who use spectroscopy in their research may benefit from the material presented. Gamma-ray, X-ray, ultraviolet, emission, visible, infrared, Raman, microwave, NMR, ESR, NQR, mass, atomic absorption, and internal reflection spectroscopy are among the methods which are examined. Recent advances in the field are reviewed, assessed, and critically evaluated, with emphasis on the applications of the latest techniques. The underlying principles of these techniques and applications are also discussed. The book edition, *Applied Spectroscopy Reviews*, is published from the journal edition to make available a complete, durable, hardbound, and fully indexed publication.

The chapters dealt with in this volume under review are: Recent Advances in Analytical Emission Spectrometry, by Anna M. Yoakum; Applications of Infrared Spectroscopy to Structure Studies of Nucleic Acids, by Masamichi Tsuboi; Infrared Studies of Hydrogen-Deuterium Exchange in Biological Molecule, by Frank S. Parker and K. R. Bhaskar; Application of X-Ray Spectroscopy to Clinical Analyses and Biological Research, by Samuel Natelson; Electronic Spectra of Radical Ions, by C. N. R. Rao, V. Kalyanaraman, and M. V. George; Quantitative Analysis by Infrared Spectrophotometry, by John A. Perry; and The Combination of Gas Chromatography with Mass Spectrometry, by C. Merrit, Jr.

Organic chemists, biochemists, spectroscopists, and students and teachers in various fields will find this book required reading.

C. V. R.

Theories of Chemical Reaction Rates. By Keith J. Laidler. (McGraw-Hill Book Company, 330 West 42nd Street, New York, N.Y. 10036), 1970. Pp. 234.

This book, based on a course of lectures given by the author at British Universities in 1966-67, discusses the various fundamental theories advanced to interpret and predict the rates of chemical reactions. Eyring's activated complex theory is elaborately dealt with, as also the more recent dynamical theories which have arisen as a result of new developments of techniques that have made possible detailed probing into the mechanisms of elementary processes in chemical reactions. Emphasis has been to indicate the applicability of the theories to the experimental data. The coverage includes unimolecular gas reactions, molecular dynamics and latest theories of chemical kinetics. The author is professor of chemistry in the University of Ottawa, and author of several books on theoretical chemical kinetics.

A. S. G.

Modern Physical Theory. (*Special Relativity and Quantum Physics*). By T. D. Sanders. (Addison-Wesley Publishing Company, Inc., West End House, 11 Hills Place, London, W. 1, Ehgland), 1970. Pp. 588.

This is a text-book on theoretical modern physics intended for seniors and graduate students majoring in physics. The emphasis is on mathematical formulation of fundamental ideas embodied in special relativity and quantum theory, and the development of theory in particular problems leading to quantitative equations that can be checked against experiments. A good background knowledge of vector analysis, differential equations, complex variables, and electromagnetic theory is expected on the part of the reader. The treatment includes: Four-Dimensional Formulation of Electromagnetic Theory; Hermitian Operators; Rotation Symmetry and Angular Momentum; Relativistic Quantum Theory; Many Particle Systems; Scattering Theory, etc.

A. S. G.

ANNOUNCEMENTS

Taxonomy of Vascular Plants

Dr. George H. M. Lawrence, Hunt Botanical Library, Carnegie-Mellon University, Pittsburgh, Pennsylvania, USA, 15213, is preparing a complete revision—to be in 2 volumes—of his *Taxonomy of Vascular Plants*. Botanists wishing to have their work considered in the new edition are requested to send reprints of same to him at the above address.

Especially desired are papers dealing with: taxonomic monographs of genera, any papers about their embryology, palynology, cytology, morphology, or phylogenetic and chemotaxonomic features.

Watumull Memorial Awards

Nominations are invited for the Watumull Memorial Awards open to citizens of India. Those who have contributed to the progress and betterment of the country in the fields of Science, Humanities and Social Sciences are eligible.

For nomination forms and other particulars write to: Dr. J. V. Bhat, 407, Block I, Rajajinagar, Bangalore-10.

Last date for receipt of the completed nomination forms is December 31, 1970.

Books Received

Thermal Characterization Technique (Vol. 2). *Techniques and Methods of Polymer Evaluation Series*. By P. E. Slade, Jr. and L. T. Jenkins. (Marcel Dekker, Inc., New York 10016), 1970. Pp. x + 371. Price $ 18.75.

Instrumental Analysis Manual—Modern Experiments for the Laboratory. By G. G. Guilbault and L. G. Hargis. (Marcel Dekker, Inc., New York 10016, U.S.A.), 1970. Pp. xi + 444. Price $ 7.75.

Liquid Phase Sintering. By V. N. Eremenko, Yu. V. Naidich and I. A. Lavrinenko. (Plenum Publishing Corporation, New York, N.Y. 10011), 1970. Pp. viii + 75. Price $ 20.00.

Magneto Neutron Diffraction. By Y. A. Izyumov and R. P. Ozerov. (Plenum Publishing Corporation, New York, N.Y. 10011), 1970. Pp. xviii + 598. Price $ 37.50.

Cryogenic Laboratory Equipment. By A. J. Croft. (Plenum Publishing Corporation, New York, N.Y. 10011), 1970. Pp. x + 182. Price $ 11.50.

Red Cell Metabolism and Function. Edited by G. T. Brewer. (Plenum Publishing Corporation, New York, N.Y. 10011), 1970. Pp. xvii + 390. Price $ 17.50.

Guide to Fluorescence Literature (Vol. 2). By R. A. Passwater. (Plenum Publishing Corporation, New York, N.Y. 10011), 1970. Pp. 369. Price $ 22.50.

2363-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

Sir C. V. RAMAN
1888 - 1970

We deeply regret to announce the death, on November 21 970 of Sir C. V. Raman, N.L., President, Current Science Association,

ON THE USE OF THE TERM "ARCHAEAN" IN PRECAMBRIAN STRATIGRAPHY

C. S. PICHAMUTHU
Department of Mines and Geology, Bangalore-1

THE term Archæan was introduced by J. D. Dana in 1872 to designate all the formations older than the Cambrian. In the International Geological Congress held in 1885, it was agreed to use Archæan, as a group name to include the various Precambrian systems.

The early workers who investigated the geology of Precambrian shields generally found that those regions were underlain by high-grade metamorphic rocks, intrusive rocks, and areas of less highly metamorphosed sedimentary and volcanic rocks. The high-grade metamorphic rocks were considered to be Archæan on the assumption that they were the oldest known crystalline rocks of that region. In Africa, for example, such Archæan rocks were named the Basement Complex (Somalia, Nigeria, Rhodesia, Uganda), Basement System (Kenya), or Primitive System (Southern Africa).

In Scotland, which is a classical area for Precambrian geology, the Lewisian complex of the Northwest Highlands has been referred to as the 'fundamental complex' or 'fundamental gneiss' because it was considered to be the Archæan basement on which the generally horizontal Torridonian strata lie (Peach *et al.*, 1907, p. 10).

Similarly, in India, it was found that more than half the area of the peninsula was occupied by old crystalline rocks which must have obtained their present characters at great depths. These rocks were covered in many places by younger sediments and lava flows. It is in consequence of its position with regard to the ordinary sedimentary rocks that the old crystalline group was earlier referred to as the 'Fundamental Complex'. The fundamental complex in India was found to be similar in essential respects with that of other countries, for instance, America, where this group, on account of its great age, *i.e.*, greater than that of any known fossiliferous rocks, was first named Archæan. Thus T. H. Holland (1906, p. 47) grouped under Archæan both the Dharwars and the fundamental crystalline rocks, drawing attention to the great 'break' which separates the gneisses and Dharwars from the much younger Cuddapahs and other unfossiliferous rocks of the peninsula. This unconformity between the Archæan and the Purana groups was named the Great Eparchæan Interval (Holland, 1909, p. 55). L. L. Fermor (1909, p. 236) was also substantially of the same view as Holland.

The earliest departure from the above concept was probably due to R. D. Irving (1888, p. 450) who in Canada suggested that the name Archæan of Dana, which up to that time had included all the Precambrian, be restricted to the Laurentian 'gneissic basic terrane', and that an entirely new name of equal rank with Palæozoic and Archæan be introduced to cover the formations between the gneissic series and the Cambrian. Following this proposal of Irving, the geologists of the United States Geological Survey chose the name 'Algonkian'.

In India, Holland (1913, p. 371) reviewed the group classification and summarised the reasons for defining the Archæan as generally accepted by the Geological Survey of India. Noticing the tendency of some Canadian and American geologists even as late as 1922 to use the term Archæan for all Precambrian rocks, which was a departure from Dana's final meaning of the term Archæan, Holland (1926, p. 38) suggested the adoption in India of the special term 'Vedic' for the basement complex.

Until some decades ago, the Precambrian of Sweden (Geijer, 1963, p. 85) was commonly divided into two parts, *viz.*, Archæan and post-Archæan formations. The Archæan covered 'the granite-interwoven basement', which so far was found to be impossible to divide into a series of formations separated by unconformities. As 'post-Archæan' were classified such supracrustal series that showed a distinct unconformity against the underlying Archæans.

In the United States, C. R. Van Hise (1892, p. 13) applied the term Archæan to 'granitic, gneissic and schistic rocks, among which are never found beds of quartzite, limestone, or any other indubitable clastics'. It was used in this sense for the first time in India by R. B. Foote (1895, p. 26) who limited the use of the term Archæan to the gneisses and granitoid members of the crystalline complex, thus excluding the rocks of the Dharwar system which he designated 'Lower Transition' and regarded as distinctly younger than the gneisses and gneissic granites. This was also the view of Holland who considered the Archæan Group of India to be composed of the oldest Gneissose and Schistose rocks, followed by some granites, anorthosites, charnockites, etc., and demarcated from the younger Dharwarian rocks by an Eruptive Unconformity. E. Vredenburg (1907, p. 4) also restricted the use of the term Archæan to gneissic rocks 'underlying the oldest undoubted sediments' which represent 'in part, at least, the original crust of the globe'; he excluded the khondalites which are metamorphosed sediments!

Later, Van Hise (1901, pp. 316-317) changed his original view and included in the Archæan certain sedimentary rocks like the iron formations. Till this time the Algonkian was understood to comprise all Precambrian sedimentary rocks, and the Archæan to include all pre-Algonkian formations which were supposed to be composed wholly of igneous rocks.

A Committee of the Royal Society of Canada on Stratigraphical Nomenclature recommended in 1932 that Precambrian time be divided into two eras, and that the names of the eras be Archæan and Proterozoic (Alcock, 1932, p. 119). This was accepted by the Precambrian geologists of the Geological Survey of Canada at a meeting in 1935.

In India, the term Archæan was applied to all rocks which lie stratigraphically below the Eparchæan Interval, the beds which normally succeed being described by Holland as 'Purana' which is the nominal equivalent of the Algonkian. For example, in Mysore State, which is a classic ground for Precambrian geology, B. Rama Rao (1940, p. 83) considered that except for some mafic dykes, all the other formations like the Dharwars, Peninsular Gneiss, Champion Gneiss, charnockites, felsites, and porphyry dykes, belonged to the Archæan. This was essentially what was proposed earlier by W. F. Smeeth (1916, p. 20).

The distinction between Archæan and Purana rocks is in many places so imperceptible that in Peninsular India, Fermor (1936, p. 14) took the presence of either granitic or pegmatitic intrusives as sufficient reason for referring the rocks into which they are intruded to the Archæans rather than to the Puranas, a procedure which has been sharply criticised by Holmes (1963, p. xix).

A. Holmes (1948), in an address to the International Geological Congress, suggested that Precambrian geology must be liberated from the 'tyranny of a telescoped classification in which the Archæan, be it Laurentian, Lewisian, Swaziland, or Dharwar, is regarded as a single era of world-wide distribution' because five Archæan cycles were already known and there was time enough in the geological past for double that number. According to Holmes (1963, p. xix), 'it is more than surprising that the tyranny of the Archæan—correlation by a word of seemingly magic authority—should have survived so long' especially when it is now known that many of the so-called 'Archæan rocks' are of Palæozoic age. What were once considered to be 'characteristically Archæan orogenic belts' have continued their activity well into the Palæozoic on the east and west coasts of India, as well as to the Cambrian and Ordovician phases of such orogenic activity in Kerala and Ceylon.

Geochronological investigations of the ancient unfossiliferous rocks have yielded surprising results, especially in the realisation of the great span of Precambrian time, and in the recognition of several orogenic cycles. Based on such geochronological data, attempts have recently been made to fix the upper age limit of the Archæan, but here again there is wide divergence in the views of the different workers. A. P. Vinogradov and A. I. Tugarinov (1961, pp. 492-499) put the Archæan-Proterozoic boundary at 1,900 m.y.; C. H. Stockwell and H. Williams (1964, pp. 1-29) suggested 2,500 m.y. A. B. Ronov (1964, p. 715) placed rocks with ages from 3,500 to 2,600 m.y. in the Archæan, and those with ages from 2,600 to 600 m.y. in the Proterozoic. According to L. I. Salop (1968, p. 62) the boundary is at 2,800 m.y.

Reluctance to give up the term Archæan, which has such a great geological age-span, has led to its further subdivision. For eastern Fennoscandia, Polkanov and Gerling (1960, pp. 183-191) have proposed the following cycles of sedimentation, metamorphism and magmatism :

Katarchæan (3,590-2,770 m.y.) ..	Katarchæan I—3,500-3,200 m.y. Katarchæan II—3,100-3,060 m.y.
Lower Archæan (2,770-2,150 m.y.) ..	Lower Archæan I—2,870-2,500 m.y. Lower Archæan II—2,490-2,100 m.y.
Upper Archæan (2,150-1,650 m.y.) ..	Belomorides—2,100-1,950 m.y. Svecofennides and Karelides—1,870-1,640 m.y.

Salop (1968, pp. 62-65) considers that the Archæan complex of the U.S.S.R. is more than 2,800 m.y. old. According to him, there are no indications of breaks and especially unconformities, and so there is no basis for the attempt of some geologists for distinguishing two groups separated by diastrophism such as a Kata-Archæan group (> 3,500 m.y.) and an Archæan one (2,800-3,500 m.y.); also, that the rocks whose radiometric ages are about 3,500 m.y. have not been delimited geologically from the Archæans that were metamorphosed 2,800 m.y. ago and form the same complexes with them.

In Canada, the name 'Laurentian' was being used to include all the pre-Huronian or Archæan formations (Irving, 1888, p. 450). Later recognition of the effects of more than one episode in the Laurentian 'gneissic basic terrane' rendered the term Laurentian inappropriate for use in correlating rock units and geological events (Peach and Horne, 1930, p. 23). Difficulties have also arisen in attempting to divide the Archæan basement complex characteristic of so much of the Canadian Shield. It is being realised that in the present state of information it will be most satisfactory to use local names for sedimentary belts within the basement succession, and if some correlation becomes possible, to make such parts subsidiary divisions within the Archæan (Wilson, 1965, p. 358).

It is now known that the Lewisian Complex of Scotland which was formerly considered to be Archæan contains remnants of at least two sedimentary groups and shows evidence of polyphase deformation and polymetamorphism in at least three orogenic episodes—Scourian, Inverian, and Laxfordian—dated at about 2,600 ± to 2,460 m.y. ago, 2,200 to 2,000 m.y. ago, and 1,600 to 1,300 m.y. ago, respectively (Bowes, 1968, p. 577).

Enough has been said to show that the monolithic Archæan has now been fragmented so much that the term has lost whatever stratigraphic significance it might once have had. During the enormous span of geological time comprised by the Archæan, there have been several cycles of orogenic activity. As a stratigraphic term, therefore, Archæan has practically no value. Even after the term Proterozoic was coined in 1932, there has been no consensus of opinion as to where Archæan ends and Proterozoic begins.

In India, as elsewhere, the Eparchæan boundary has been bobbing up and down in the stratigraphic scale according to the predilections of the individual worker. On the assumption that all the gneisses, granulitic gneisses such as charnockites, pyroxene granulites, etc., and amphibolites, are older than the Dharwars, S. P. Nautiyal (1966, pp. 5-6) considers them as Archæan, and the Dharwars as Proterozoic. The Dharwars have been divided by him arbitrarily into the high grade metamorphic rocks such as sillimanite, kyanite-garnet schists and gneisses, biotite schists, marbles, and quartzites, together with 'younger migmatites' which he groups under Upper Archæans; and the hornblende and chlorite schists which he considers as Lower Proterozoic. There is no geochronological or field evidence in support of these conjectures (Pichamuthu, 1970, pp. 245-247). In a polymetamorphic assemblage like the Precambrian, it is not possible to assume metamorphic grade as a function of age. In contrast to the suppositional classification of the Dharwars by Nautiyal, there is much to be said in favour of that proposed by B. P. Radhakrishna (1965, p. 105) as it is based on the general structure of the Schist Belts, as well as on the lithological succession from the oldest Bababudan series to the youngest Supa-Dandeli series.

Time is a continuum and can, therefore, be subdivided in any manner but the main object of stratigraphy is the subdivision of rock sequences in terms of time and not the subdivision of time itself. The arbitrary fixation of the upper limit of the Archæan at 2,500 or 2,600 m.y. leads to irreconcilable anomalies in the Mysore Precambrians, since such an age limit cuts across all the three prominent constituents—the Dharwar Schists, the Peninsular Gneisses, and the Charnockites. These rock sequences contain within themselves the frozen history of many episodes of metamorphism, intrusion, metasomatism, and assimilation which occurred during a long span of geological time, and hence, are not susceptible of being classified in terms of rounded units of time.

Recently, some have avoided the use of the term Archæan in Precambrian stratigraphy. F. F. Grout and his associates (1951, p. 1021) proposed a three-fold time division into Earlier, Medial, and Later eras for the Precambrian of northern Minnesota. H. L. James (1955, p. 1459) classified the Precambrian rocks of northern Michigan into Lower, Middle, and Upper parts. In the third report of the American Commission on Stratigraphic Nomenclature (Harrison, 1955, p. 1859), it was recommended that the major divisions of Precambrian time, approximately equal to eras, be known as Early Precambrian and Late Precambrian.

In view of the various uncertainties in the Precambrian stratigraphy of India, S. N. Sarkar (1968, pp. 23-25) has suggested that the Precambrian be classified into five groups, thus avoiding the controversy regarding the exact position of the Eparchæan Interval which, according to Holmes (1955, p. 97) only connotes 'a mental telescoping of several such intervals'. The three oldest groups in this classification are as follows :

Precambrian I (3,000 to 3,500 m.y.) Older Metamorphics ; Basement Complex.
Precambrian II (2,500 to 3,000 m.y.) Iron Ore, Dharwar, B.G. Complex.
Precambrian III (1,600 to 2,500 m.y.) Satpura and Aravalli (in part).

At present, one is not certain how ancient or how characteristic the rock sequences of the 'Archæan' are, and hence, there seems to be no justification for continuing the use of this term in Precambrian stratigraphy.

---

1. Alcock, F. J., "A national committee on stratigraphical nomenclature," *Trans. Roy. Soc. Canada*, 1932, **26**.
2. Bowes, D. R., "The Lewisian of Northwest Highlands of Scotland : North Atlantic—Geology and Continental Drift," *Amer. Assoc. Petrol. Geol.*, 1968, Mem. **12**.
3. Dana, J. D., "Green Mountain Geology ; on the quartzite," *Amer. Jour. Sci.*, 1872, **2**, 253.
4. Fermor, L. L., "The manganese-ore deposits of India," *Mem. Geol. Surv. Ind.*, 1909, **37**.
5. —, "An attempt at the correlation of the ancient schistose formations of Peninsular India," *Ibid.*, 1936, **70**.
6. Foote, R. B., "The geology of the Bellary District, Madras Presidency," *Ibid.*, 1895, **25**.
7. Geijer, P., "The Precambrian of Sweden," in *The Precambrian*, Interscience Publishers, New York and London, 1963, **1**.
8. Grout, F. F. *et al.*, "Precambrian Stratigraphy of Minnesota," *Bull. Geol. Soc. Amer.*, 1951, **62**.
9. Harrison, J. M., "Nature, usage, and nomenclature of time-stratigraphic and geologic-time units as applied to the Precambrian," *Bull. Amer. Assoc. Petrol. Geol.*, 1955, **39**.
10. Hise, C. R. V., *Bull. U.S. Geol. Surv.*, 1892, **86**.
11. —, *21st Annual Report, U.S. Geol. Surv.*, 1901, Part 3.
12. Holland, T. H., "Presidential address," *Trans. Min. Geol. Inst. Ind.*, 1906, **1**.
13. —, *The Imperial Gazetteer of India*, 1909, **1**.
14. —, *Compte Rendu. Cong. Geol. Inter.*, 12th Session, Canada, 1913.
15. —, "Indian Geological Terminology," *Mem. Geol. Surv. Ind.*, 1926, **51**.
16. Holmes, A., *Inter. Geol. Cong.*, 1948.
17. —, "Dating the Precambrians of Peninsular India and Ceylon," *Proc. Geol. Assoc. Canada*, 1955, **7**.
18. —, "Introduction," *The Precambrian*, Interscience Publishers, New York and London, 1963, **1**.
19. Irving, R. D., "On the classification of the early Cambrian and Precambrian formations, a brief discussion of principles, illustrated by examples drawn mainly from the Lake Superior Region," *U.S. Geol. Surv., Ann. Report*, 1888, **7**.
20. James, H. L., "Zones of regional metamorphism in the Precambrian of northern Michigan," *Bull. Geol. Soc. Amer.*, 1955, **66**.
21. Nautiyal, S. P., "Precambrian of Mysore Plateau," *Presidential Address, Section of Geology and Geography, 53rd Ind. Sci. Cong.*, 1966.
22. Peach, B. N. *et al.*, "The geological structure of the Northwest Highlands of Scotland," *Mem. Geol. Survy. Great Britain*, 1907.
23. — and Horne, J., *Chapters on the Geology of Scotland*, Oxford, 1930.
24. Pichamuthu, C. S., "The problem of the basement in Mysore State," *Curr. Sci.*, 1970, **39**.
25. Polkanov, A. A. and Gerling, E. K., "Precambrian geochronology of the Baltic Shield," *Rept. 21st Session, Inter. Geol. Cong Proc.*, 1960, Part 9.
26. Radhakrishna, B. P., "Reconsideration of some problems in the Archæan Complex of Mysore," *Jour. Geol. Soc. Ind.*, 1967, **8**.
27. Ronov, A. B., "Common tendencies in the chemical evolution of the earth's crust, ocean and atmosphere," *Geochem. Inter.*, 1964, **4**.
28. Salop, L. I., "Precambrian of the U.S.S.R.," *Rept. 23rd Session, Inter. Geol. Cong. Proc.*, Sec. 4, 1968.
29. Sarkar, S. N., *Precambrian Stratigraphy and Geochronology of Peninsular India*, Dhanbad Publishers, India, 1968.
30. Stockwell, C. H. and Williams, H., "Age determination and geologic studies," *Geol. Surv. Canada*, 1964, Pap. 61–17.
31. Vinogradov, A. P. and Tugarinov, A. I., "The geologic age of Precambrian rocks of the Ukrainian and Baltic Shields. Geochronology of Rock Systems," *Annals New York Acad. Sci.*, 1961, **91**.
32. Vredenburg, E., *A Summary of the Geology of India*, Calcutta, 1907.
33. Wilson, M. E., "The Precambrian of Canada, the Canadian Shield," in *The Precambrian*, Interscience Publisher, New York and London, 1965, **2**.

A NOTE ON THE BRYOZOANS OF THE SHELF SEDIMENTS OFF VISAKHAPATNAM

M. SUBBA RAO AND T. KAMESWARA RAO
Geology Department, Andhra University, Waltair

EARLY work on the sediments of the continental shelf off Visakhapatnam and the east coast of India has been reported from this department.[1-4] Of the important groups of microfauna, such as the Foraminifera, Ostracoda, Polyzoa (Bryozoa), Mollusca, etc., whose remains have been found to be well distributed in these sediments, it is the Foraminifera that has received considerable attention.[5-8] The authors have undertaken studies on the ostracod and bryozoan assemblages of these shelf sediments and it is the purpose of this note to give a preliminary account of the bryozoan fauna of the sediments of the continental shelf off Visakhapatnam, on the east coast of India.

Many sediment samples were obtained during the years 1952-57 and in 1964 from the continental shelf off the east coast of India, north of Madras, using the Lafond-Dietz snapper type sampler. Of these, twenty-five samples covering a depth range of 11·5 to 104 fathoms and representative of the different types of sediments carpeting the shelf right off Visakhapatnam have been selected for the present study. The station locations where these samples were obtained are shown in the figure.

Suitable aliquots of the sediment samples were disaggregated overnight with sodium-hexametaphosphate solution and washed through a sieve of 0·062 mm. openings until the material was cleared of silt and clay. The residue on the sieve was dried and sieved through a series of sieves of 0·5 mm., 0·25 mm., and 0·125 mm. openings respectively. The sieved fractions were examined under a binocular microscope for the bryozoan faunal remains which were found mostly in the coarser two fractions of the material.

A total of twenty-three bryozoan species have been recognised in the marine sediments off Visakhapatnam. Of these, one is a cyclostome and the rest are all cheilostomes. The following is the list of fauna encountered in the area :

Actisecose regularis, *Calyptotheca suluensis*, *Celleporaria aperta*, *Cleidochasma areolatum*, *Escharina pesensaris*, *Hippaliosina acutirostris*, *H. spathulifera*, *Microporella orientalis*, *Mucropetraliella thenardii*, *Nellia tenella*, *Schismopora redoutei*, *Setosellina constricta*, *Smittipora abyssicola*, *Spiroporina longicollis*, *Steganoporella* cf. *sulcata*, *Cyclostomata crisiaelongata*, *Adeonellopsis* sp., *Cellaria* sp., **Lacrimula* sp., *Lagenipora* sp., *Rhynchozoon* sp., and *Scrupocellaria* sp. In addition, one Reteporid has been found. (*Miss P. L. Cook of the British Museum—Natural History, who was shown this material opined that Lacrimula species is a new one.)

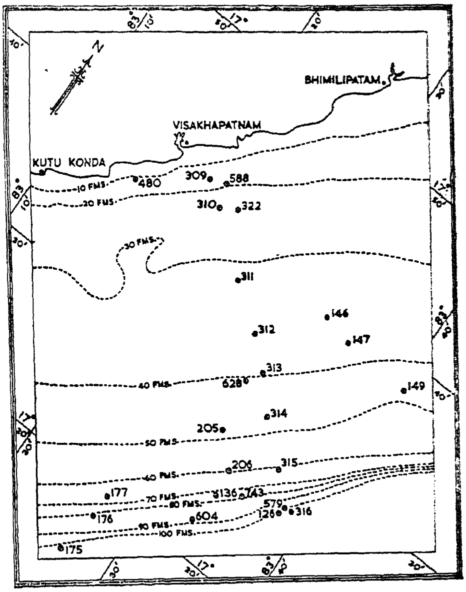


FIG. 1. Figure showing sample locations off Visakhapatnam.

No bryozoan fauna is found at depths less than 30 fathoms and also at depths of 70-90 fathoms. The middle shelf (30-70 fathoms) is richer in bryozoan fauna both in abundance and variety than the outermost shelf (90 fathoms and deeper). However, sediments from the depth range of 45-50 fathoms yielded the highest number of thirteen species.

Hippaliosina acutirostris is the only deep-water species occurring at 104 fathoms depth while *Steganoporella* cf. *sulcata* which is represented by only one specimen is restricted in its occurrence to a depth around 10 fathoms.

Of the remaining twenty-one species, five are present throughout the middle shelf :

Actisecose regularis, *Cellaria* sp., *Cleidochasma areolatum*, *Spiroporina longicollis* and *Scrupocellaria* sp.

Five species are found to occur not only in the entire middle shelf but also in the deep-water sediments beyond the shelf edge:

Cyclostomata crisiaelongata, Hippaliosina, spathulifera, Lacrimula sp., *Nellia tenella* and *Setosellina constricta.*

Three species are restricted to the depths of 45-50 fathoms:

Micropetraliella thenardii, Schismopora redoutei, and *Smittipora abyssicola.*

Two species are restricted to 35 fathoms depth:

Celleporaria aperta and *Reteporid* sp.

Six species are erratic in their distribution:

Adeonellopsis sp., *Calyptotheca suluensis, Escharina pesensaris, Lagenipora* sp., *Microporella orientalis,* and *Rhynchozoon* sp.

Subba Rao[4] recognised the following sediment types across the shelf off Visakhapatnam as one proceeds seaward from the shore:

Nearshore sands and clayey sands (0-25 fathoms), silty clays (25-30 fathoms), Sand-silt-clay (30-40 fathoms), Relict clayey sands (40-65 fathoms), Oolitic sands (65-80 fathoms), and clayey (foraminiferal) sands on the outermost parts of the shelf.

It is significant to note that the nearshore sands and the silty clays do not support bryozoan fauna. However, the intertidal beach at Visakhapatnam is reported to have yielded 60 species of ectoproct fauna.[9]

Harmer's data[10] shows that most of the species reported here have a depth distribution of 0-60 metres and their occurrence in abundance and variety off Visakhapatnam at depths of 30-70 fathoms looks rather anomalous. The sediments present at this depth range have been shown to be relict, reworked and mixed considerably with modern sedimentary products.[2-4] The association of the bryozoan specimens with such relict sediments leads to the suspicion that some of them must also be relict and they must have been developed there during the Pleistocene low stands of the Bay of Bengal and consequently they are not endemic to the depths where they are found now. The much worn-out nature of a good number of specimens lends proof to their being reworked and involved probably in transportation along with other sedimentary materials with which they are associated.

The authors are grateful to Miss Patricia L. Cook of the British Museum (Natural History) who kindly checked with their identification of the species. One of them (T. K. R.) is grateful to the CSIR for a Junior Research Fellowship.

1. Mahadevan. C. and Poornachandra Rao, M., *Andhra Univ. Mem. Oceanog.*, 1954, **1**, 1.
2. Poornachandra Rao, M., *Congr. Pan Indian Ocean Sci. Assoc., Compt. Rend.*, 3e, Tananarive, 1957, Sect. C, p. 143.
3. Subba Rao, M , *J. Sediment Petrol.*, 1958, **28**, 274.
4. —, *J. Marine Geol.*, 1964, **1**, 59.
5. Ganapati, P. N. and Satyavati, P., *Andhra Univ. Mem. Oceanog.*, 1958, **2**, 100.
6. — and Sarojini, D., *Proc. All-India Congr. Zool.*, 1st, Calcutta, 2, Sci Papers, 1959 p 311.
7. Subba Rao, M. and Vedantam, D., *Bull. Nat Inst. Sci. India*, 1968, **38**, 491.
8. Vedantam, D. and Subba Rao, M., *Micropaleontology*, 1970, p. 16.
9. Ganapati, P. N., Satyanarayana Rao, K. and Lakshmana Rao, M. V., *Curr. Sci.*, 1969, **38**, 387.
10. Harmer, S. F., *Rep. Siboga Exped.*, 1957, **28**, Part 4, 641.

EFFECT OF ETHREL, NAA AND NAD ON THE INDUCTION OF FLOWERING IN PINEAPPLE (*ANANAS COMOSUS* L.)*

G. S. RANDHAWA, H. C. DASS AND E. K. CHACKO

Institute of Horticultural Research (ICAR), 255, Upper Palace Orchards, Bangalore-6

ONE of the major impediments in the successful cultivation of pineapple is its erratic flowering behaviour. Even after 15-18 months' of growth, under optimum nutritional and climatic conditions, less than 20% of the plants normally flower. Since pineapple is mostly grown for canning, irregular flowering makes it difficult for growers to regulate supply of fruits to the canning factories.

Artificial induction of flowering in pineapple has been tried with various plant growth regulators in the past and some degree of success has been achieved.[1-2, 4-7, 9-10] Out of these, naphthaleneacetic acid (NAA) has shown promise for commercial use. Recently, a new chemical, namely, Ethrel (2-chloroethane phosphonic acid) has been reported to be effective in

---

* Contribution No. 55 of the Institute of Horticultural Research, Hessaraghatta, Bangalore.

inducing flowering in pineapple.[3] The results of our studies on the comparative effectiveness of ethrel, naphthaleneacetic acid and naphthalene acetamide (NAD) in the induction of flowering in Kew variety of pineapple are presented in this report.

Two trials consisting of 10 and 12 months' old pineapple plants, having a minimum number of 45 leaves, were conducted during March and May, 1970, at the Pineapple Farm of the Kushalnagar Co-operative Society in Coorg District, Mysore. Forty ml. each of the chemicals, namely, ethrel (2,000, 1,000, 500, 250, 125 and 62·5 ppm) NAA, and NAD (20, 10 and 5 ppm) were poured into the centre of individual plants. For each concentration, a total of 180 plants were treated giving three replications of 60 plants each. The percentage of natural flowering under each treatment was recorded at the beginning of the experiment.

The percentage of flowering induced by various concentrations of the chemicals as well as in control plots after 50 and 90 days of the treatment are presented in Table I.

TABLE I

Comparative effect of ethrel, NAA and NAD on the induction of flowering in pineapple

Growth regulator concentrations			Experiment I	Experiment II
			Percentage of flowering after	
			50 days	90 days
Ethrel	2,000 ppm	..	93·2	9[illegible]·72
	1,000 ,,	..	90·0	97·87
	500 ,,	..	87·4	97·22
	250 ,,	..	91·0	96·66
	125 ,,	..	90·0	92·30
	62·5 ,,	..	..	87·46
NAA	20 ,,	..	63·88	53·13
	10 ,,	..	64·44	75·20
	5 ,,	..	58·88	86·00
NAD	20 ,,	..	45·00	30·56
	10 ,,	..	61·00	55·55
	5 ,,	..	27·22	59·37
Control	..	..	17·22	24·24

Table I shows that all chemicals were effective in inducing flowering in pineapple as compared to control. Ethrel particularly induced a sharp peak of flower initiation at all the concentrations tried within 50 days of the treatment. Next to ethrel, NAA was effective, but the results during the two trials showed a wide variation with regard to the effectiveness of different concentrations. March application showed higher concentrations of NAA (20 and 10 ppm) more effective for maximum flower induction than lower concentration (5 ppm). In May application, however, 5 ppm was found more effective than 10 and 20 ppm NAA. Similar results were also obtained with naphthalene acetamide, but this chemical was found less effective than ethrel and NAA. However, the effect of ethrel was very consistent, forcing nearly 90% of the plants to flower within a period of 50 days of application. It was also noticed that flower initiation in ethrel-treated plants was very uniform as compared to NAA and NAD-treated plants where flower initiation continued during a longer period. Since ethrel treatment induces uniform flowering, the grower need not go to the same fields several times for harvesting.

It has been reported that unsaturated hydrocarbons like ethylene and acetylene are capable of forcing pineapple plants to flower.[8-10] Since it is known that ethrel induces the formation of ethylene in the plant system, it is possible that ethylene is the primary factor responsible for the flower-inducing properties of ethrel in pineapple. The recent findings that application of auxins to plants induces the formation of ethylene in the plant system also strongly suggest that flower initiation in pineapple is controlled by ethylene or similar hydrocarbons. Substances like ethrel, auxins, calcium carbide or even smoke affect flowering through the liberation of ethylene in the plant system.

The present results also clearly show the superiority of ethrel over auxins like NAA and NAD in forcing pineapple plants which should facilitate the farmers to predict the harvesting period and evolve a programmed supply schedule of fruits to the canneries all around the year. Further studies are in progress regarding the effect of ethrel on fruit yield, size, canning quality, slip and sucker production as well as the metabolic changes taking place in the treated plants prior to and during flower initiation.

The authors feel grateful to Amchem Products, Inc., Ambler, Pennsylvania, U.S.A., for supplying free gift of ethrel (ACP 68-250). Thanks are also due to the Kushalnagar Fruit and Vegetable Processing Co-operative Society for permission to conduct these experiments at their pineapple farm.

---

1. Clark, H. E. and Kerns, K. R., *Science*, 1942, **95**, 536.
2. — and —, *Bot. Gaz.*, 1943, **104**, 639.
3. Cooke, A. R. and Randall, D. I., *Nature*, 1968, **281**, 974.
4. Gonzalez Avila, P., *Agronomica* (Lima), 1956, **22**, 107.
5. Gowing, D. P., *Plant Physiol.*, 1958, **33** (Suppl. xx).
6. — and Leeper, R. W., *Science*, 1955, **122**, 1267.
7. Kerns, K. R., *U.S. Patent 2047*, 1936, p. 874.
8. Rodriguez, A. G., *Jour. Dept. Agr. Puerto Rico*, 1932, **26**, 5.
9. van Overbeek, J., *Science*, 1945, **102**, 61.
10. Wendt, W. A., *U.S. Pat. 2037*, 1936, p. 203

LETTERS TO THE EDITOR

POLYMERIZATION OF AQUEOUS ACRYLIC ACID PHOTO-INITIATED BY MONO- AND DI-AZIDO COBALT (III) AMINES

QUALITATIVE studies on the photolysis of azidopentamine-cobalt (III) complexes by Linhard *et al.*[1] and Adamson *et al.*[2] followed by detailed kinetic studies by Natarajan and Santappa[3-5] on the polymerization of aqueous vinyl monomers photo-initiated by the complex established that N_3 radicals were the initiating species. In the present study it was found that irradiation of azidopentaminecobalt (III) complex as well as diazidotetraminecobalt (III) complexes at $\lambda \gtrsim 365$ mμ led to the evolution of nitrogen in the absence of any monomer, while in the presence of acrylic acid, monomer, initiation of the polymerization of the latter was observed under deaerated conditions. The kinetics of: (*a*) the decomposition of the complexes was followed both spectrophotometrically and by the volume of nitrogen evolved (for azidopentamine complex), (*b*) the rate of polymerization of the monomer was followed by determining the rate of disappearance of the monomer, $-d[\mathrm{M}]/dt$, bromometrically, (*c*) the disappearance of the complex $-d[\mathrm{C}]/dt$, was followed spectrophotometrically using a calibrated Beer's law curve (at $\lambda = 300$ mμ, $\epsilon = 8590$ for monoazido and at $\lambda 340$ mμ, $\epsilon = 14{,}400$ for the diazido complex), and (*d*) the chainlengths (*n*) of polyacrylic acid samples were determined viscometrically using the Mark-Houwink relationship.[6]

We have observed that: (*i*) initiation of polymerization under deaerated conditions was photochemical in nature and not thermal, (*ii*) steady state was attained in about 15 minutes with ≈ 30% conversion of the monomer, (*iii*) decomposition of the complex in the absence of the monomer was first order with respect to the former, (*iv*) the values of $-d[\mathrm{M}]/dt$ were proportional to $[\mathrm{M}]^{2/3}$, $k_\epsilon^{\frac{1}{2}}$ and $\mathrm{I}^{\frac{1}{2}}$ in the case of azidopentamine complex and to $[\mathrm{M}]^2$, k_ϵ and I in the case of diazidotetramine complex, (*vi*) the rate of polymerization was independent of $[\mathrm{H}^+]$, (*vii*) $-d[\mathrm{C}]/dt$ was proportional to k_ϵ and I in both the cases, and (*viii*) *n* was proportional to $[\mathrm{M}]^{\frac{1}{2}}$, $k_\epsilon^{-\frac{1}{2}}$ and $\mathrm{I}^{-\frac{1}{2}}$ for the monoazido initiator and proportional to [M] and $[\mathrm{C}]^{-1}$ in the case of diazido initiator.

Our experimental observations of the polymerization reactions were explained by the reaction scheme consisting of: (*a*) photo-excitation of the complex, (k_ϵI), (*b*) dark back reaction leading to the de-excitation of the complex (k_d), (*c*) redox decomposition of the excited complexes yielding the azide radical (k_r), (*d*) initiation of polymerization by the azide radical (k_i), (*e*) propagation of polymerization (k_p), (*f*) termination by mutual combination of the radicals (k_{t3}) for monoazido initiator, (*g*) termination by the complex molecules (k_{t1}) for diazido initiator, and (*h*) radical scavenging by and the consequent reduction of the complex (k_2).

Assuming stationary state concentrations for the reactive species, the rate expressions for monoazido initiator derived were:

$$-d[\mathrm{M}]/dt = \frac{k_p k_i^{1/2} k_r^{1/2} k_\epsilon^{1/2} \mathrm{I}^{1/2} [\mathrm{M}]^{3/2}}{k_{t_3}^{1/2} (k_r + k_d)^{1/2} (k_i [\mathrm{M}] + k_2 [\mathrm{C}])^{1/2}} \quad (1)$$

$$-d[\mathrm{C}]/dt = \left\{1 + \frac{k_2 [\mathrm{C}]}{k_i [\mathrm{M}] + k_2 [\mathrm{C}]}\right\} \frac{k_r}{k_r + k_d} k_\epsilon \mathrm{I} \quad (2)$$

and

$$n = \frac{k_p [\mathrm{M}]^{1/2} (k_r + k_d)^{1/2} (k_i [\mathrm{M}] + k_2 [\mathrm{C}])^{1/2}}{k_{t_3}^{1/2} k_i^{1/2} k_r^{1/2} k_\epsilon^{1/2} \mathrm{I}^{1/2}}. \quad (3)$$

Similarly, for the diazido complex:

$$-d[\mathrm{M}]/dt = \frac{k_p k_i k_r k_\epsilon \mathrm{I} [\mathrm{M}]^2}{(k_{t_1} [\mathrm{C}]) (k_d + k_r) \{(k_i [\mathrm{M}] + k_2 [\mathrm{C}])\}} \quad (4)$$

$$-d[\mathrm{C}]/dt = \frac{2k_r}{(k_d + k)_r} k_\epsilon \mathrm{I} \quad (5)$$

and

$$n = \frac{k_p [\mathrm{M}]}{k_{t_1} [\mathrm{C}]}. \quad (6)$$

Rate expressions derived on the basis of initiation by the excited complex, terminations by the primary radical or by the excited complex did not conform to experimental results.

ϕ_{net} for the disappearance of azidopentamine complex was found to be $\sim 0 \cdot 19$ at $\lambda = 365$ mμ both in the presence and absence of the monomer while the value of $k_p/k_t^{\frac{1}{2}} \approx 3 \cdot 4$ (mole./1)$^{\frac{1}{2}}$ sec.$^{-\frac{1}{2}}$ was obtained from plots of $-d[\mathrm{M}]/dt$ and $-d[\mathrm{C}]/dt$ against the variables. ϕ_{net} for the disappearance of diazidotetramine complex was found to be $\sim 0 \cdot 27$ at $\lambda = 365$ mμ both in the presence and absence of the monomer while the value of $k_p/k_t \approx 14$ was obtained from plots of $-d[M]/dt$ against the variables.

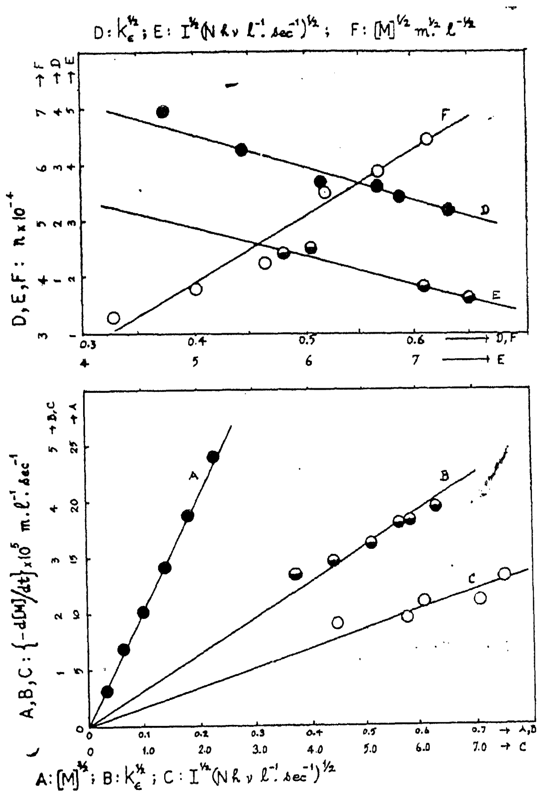


FIG. 1. Polymerization of Acrylic acid photo-initiated by azidopentamine cobalt (III) chloride at $\lambda = 365$ mμ.

ϕ_{net} for diazidotetramine complex is reported for the first time and the $k_p/k_t^{\frac{1}{2}}$ and k_p/k_t values for acrylic acid polymerization are being reported for the first time by any initiator.

Dept. of Physical Chemistry,
University of Madras,
Madras-25, *August* 13, 1970.

H. KOTHANDARAMAN.
M. SANTAPPA.

---

1. Linhard, M. and Weigel, M., *Z. anorg. allgem. Chem.*, 1951, **266**, 49.
2. Adamson, A. W. and Penkett, S. A., *J. Am. Chem. Soc.*, 1965, **87**, 2514.
3. Natarajan, L. V. and Santappa, M., *Polymer Letters*, 1967, **5**, 357.
4. — and —, *J. Polymer Sci.*, 1968, **6**, Part A-1, 3245.
5. Santappa, M. and Natarajan, L. V., *The Proceedings of the Indian Academy of Sciences*, 1969, **69** (4), Sec. A, 284.
6. Newman, S., Krigbaum, W. R., Laugier, C. and Flory, P. J., *J. Polymer Sci.*, 1954, **14**, 451.

SOME NEW PHARMACOLOGICAL PROPERTIES OF FLAVONOIDS AND BIFLAVONOIDS

AN extract of *Ginkgo biloba* L. is marketed in West Germany under the name "Tebonin".[1] It has been claimed that (1) this drug possesses blood-flow increasing and vascular dilating properties and is recommended for use in hormonal, vascular, blood-flow and nutritional disorders, (2) the use of Tebonin over a long period leads to the healing of chronic vasotropic ulcers, (3) cerebral blood-flow deficiency due to cerebrosclerotic vascular processes also responds favourably, and (4) in cases of high blood pressure "Tebonin" has beneficial effects while in normal or low blood pressure, no effect is noticed.

The leaves of *Ginkgo biloba* contain biflavonoids of the ginkgetin group and some simpler flavonoids. In view of the interesting physiological activities attributed to "Tebonin", a study of certain other pharmacological properties of some flavonoids and biflavonoids has now been carried out. Tables I, II and III summarize the main findings.

TABLE I
Peripheral vasodilation on rat hind limb preparations[2]

No.	Compound	Activity %
1	Papaverine hydrochloride (Control)	100
2	Mixture of *Ginkgo* biflavones ..	75
3	Cupressuflavone ..	50
4	Apigenin ..	0
5	Apigenin-7, 4′-dimethyl ether ..	0
6	Acacetin ..	0

TABLE II
Antibradykinin activity on guinea-pig ileum preparations[3]

No	Compound	ED$_{50}$ and range (μg/ml.)	Potency
1	Mixture of *Ginkgo* biflavones	75 (50 100)	3+
2	Cupressuflavone ..	,,	3+
3	Apigenin ..	200	+
4	Apigenin-7, 4′-dimethyl ether	,,	2+
5	Acacetin ..	,,	+
6	Genkwanin ..	,,	+

+ = 25%, 2+ = 50% and 3+ = 75% inhibition.

The mixture of *Gingko* biflavones was obtained by extraction of *G. biloba* leaves obtained from Germany and kindly supplied by Dr. Dwarakanath. Cupressuflavone was isolated from the leaves of *Cupressus torulosa* kindly supplied by Dr. P. N. Chatterjee. The other

TABLE III

Antispasmogenic action against prostaglandin PGE_1 on guinea-pig ileum preparations[4]

No.	Compound		Percentage inhibition
1	Quercetin	..	100
2	Naringenin	..	100
3	Homo-eriodictyol	..	50
4	Myricetin	..	100
5	Morin	..	100
6	Quercetin-7-methyl ether	..	100
7	Cyanidin hydrochloride	..	0

flavonoids were prepared from natural sources or synthetically at different times in the course of other work in this laboratory.

The details of the methods employed for pharmacological studies of the flavonoids and biflavonoids and the significance of these findings in the light of relevant literature and discussion will be reported elsewhere.

Dept. of Chemistry, S. NATARAJAN.
University of Delhi, V. V. S. MURTI.
Delhi-7; and T. R. SESHADRI.
Dept. of Pharmacology, A. S. RAMASWAMY.
All-India Institute of Medical Sciences,
New Delhi-16, *August* 17, 1970.

---

1. Peter, H., Fiesel, J. and Weisser, W., *Arzneimittel Forsch.*, 1966, **16**, 719.
2. Burn, J. H., *Practical Pharmacology*, Blackwell Scientific Publications, Oxford, 1952.
3. Perry, W. L. M., Ed., *Pharmacological Experiments on Isolated Preparations*, E. & S. Livingstone, London, 1968.
4. Horton, E. W. and Main, I. H. M., *British Journal of Pharmacology*, 1963, **21**, 182.

COMPLEMENTARY ACTION OF POTASSIUM AND BENZYLAMINOPURINE ON GROWTH, CHLOROPHYLL, PROTEIN AND RNA SYNTHESIS IN CUCUMBER COTYLEDONS

IT has been found that KCl stimulates growth and chlorophyll synthesis in detached cucumber cotyledons,[1] and suggested that K^+ accelerates synthesis of either proteins or nucleic acids.[2]

To prove this assumption, the cotyledons, dissected from etiolated 5-day-old *Cucumis sativus* L. var. 'Delicatess' seedlings, were incubated[2] with water, KCl and benzylaminopurine (BAP) for 21 hours in light at 24° and then transferred into solutions of leucine-U-^{14}C (1 μCi/ml.) or uracil-2-^{14}C (5 μCi/ml.) for 3 hours (light of 1,400 lux; 24°). Each incubational medium contained penicillin G, 50 mg./*l*. RNA, protein and chlorophyll were extracted and estimated according to modified[3] methods.[4-6] Radioactivity was counted under SSU-4 W scintillation detector with a counting efficiency of approximately 20%.

BAP increased the net growth by about 200%, slightly affecting chlorophyll accumulation. KCl threefold and twofold stimulated growth and chlorophyll synthesis, respectively. Both compounds synergistically accelerated growth of the cotyledons (Table I).

The compounds had little effect on the content of protein. BAP markedly enhanced the level of RNA per cotyledon basis. KCl stimu-

TABLE I

Synthesis of protein and RNA in detached cucumber cotyledons, pretreated with KCl (0·025 M) and BAP (10^{-5} M) in light

		Original cotyledons	After 21 (+3) hours in:				L.S.D. P = 0·01
			Water (Control)	KCl	BAP	KCl+BAP	
Fresh weight, mg./cotyledon	..	19·7	25·6	36·3	32·0	45·5	1·0
Chlorophyll, μg/cotyledon	..	0	18·0	38·0	20·0	49·2	1·7
Protein, mg./cotyledon	..	1·12	1·08	1·00	1·05	1·03	0·05
RNA, μg./cotyledon	..	93·0	138·4	158·0	206·8	215·4	10·2
		Feeding with leucine-^{14}C for 3 hr.					
80% ethanol soluble compounds, counts/min/cotyledon		1,240	1,330	2,060	1 440	2,010	230
Protein, counts/min./cotyledon	..	600	3,160	8.200	3,550	5.590	320
Specific activity of protein, counts/min./mg.		535	2 940	8 200	3,380	5,430	310
		Feeding with uracil-^{14}C for 3 hr.					
Methanol soluble compounds, counts/min./cotyledon		1,470	3,180	4,380	4,280	6,600	340
RNA, counts/min./cotyledon	..	150	910	793	2 064	2,154	150
Specific activity of RNA, counts/min./μg.	..	1·60	6·57	5·02	9·98	10·00	1·5

Original cotyledons were incubated with radioactive precursors immediately after dissecting.

lated leucine-^{14}C incorporation into proteins by 250%, and slightly reduced synthesis of RNA. BAP, on the contrary, little affected protein synthesis and doubled the rate of uracil-^{14}C incorporation into RNA per cotyledon basis. In the cotyledons pretreated with KCl + BAP the synthesis of protein was less intense than in the KCl alone treated sample, but markedly higher than in the water-treated control; synthesis of RNA was as intense as in the BAP alone treated series.

KCl accelerated uptake of labelled leucine and uracil from the media; BAP stimulated uptake of uracil only (Table I).

It seems that K^+ stimulates growth and chlorophyll accumulation owing to a selective acceleration of protein synthesis. BAP primarily induces RNA synthesis. In consequence, the highest growth rate is manifested by KCl + BAP-treated cotyledons because in this case the accelerated synthesis of proteins is preceded by (and accompanied with) the accelerated synthesis of ribonucleic acids.

This study was supported by the State Board for Peaceful Use of Atomic Energy, Warsaw.

Dept. of Plant Physiology, J. S. KNYPL.
University of Lodz,
Lodz, Poland, *August* 17, 1970.

---

1. Knypl, J. N., *Nature* (*Lond.*), 1969, **224**, 1025.
2. — and Rennert, A., *Z. Pflanzenphysiol.*, 1970, **62**, 97.
3. —, *Acta Soc. Bot. Polon.* (In press).
4. Cherry, J. H., *Plant Physiol.*, 1962, **37**, 670.
5. Fletcher, R. A. and Osborne, D. J., *Nature* (*Lond.*), 1965, **207**, 1176.
6. Bruinsma, J., *Photochem. Photobiol.*, 1963, **2**, 249.

HEMIDACTYLUS FLAVIVIRIDIS A PARATENIC HOST OF *RICTULARIA CAHIRENSIS*

OF the two species of *Rictularia* Frölich, 1802, known from carnivores, *R. cahirensis* Jägerskiöld, 1904 has been recorded in dog, cat and several wild carnivores.[1-5,8] Finding of encysted larvæ of this species at Mukteswar-Kumaon from serous coats of lizard was reported.[8] In *R. colorodensis* (parasitic in white-footed mouse), some species of crickets and cockroaches have been found as vectors in natural and experimental infections and the flour beetle too has experimentally been incriminated.[6,7,9]

Numerous specimens of *Hemidactylus flaviviridis*, collected locally and from Agra, yielded encysted nematode larvæ from the gastric and intestinal walls on many occasions. On extraction, the nearly spherical and whitish cysts of 0·198–0·208 × 0·229–0·254 mm. in diameter revealed coiled juveniles. The actively motile excysted stage, of 0·710–0·961 mm. in length and 0·032–0·061 mm. in maximum breadth, had a cylindrical buccal capsule of 0·009–0·013 × 0·006–0·014 mm. size with prominent lips and leading to the œsophagus in two parts—the anterior muscular of 0·086–0·139 mm. with the brain mass lying nearly in middle at 0·068–0·091 mm. and the excretory pore towards its posterior region at 0·097–0·149 mm. behind the anterior end respectively and the 0·214–0·270 mm. long posterior glandular part. The 0·029–0·042 mm. long rectum was surrounded by the three unicellular rectal glands. The tail, of 0·048–0·052 mm. length and lacking caudal processes at the tip, revealed a pair of small papillæ situated at 0·017–0·022 mm. in front of the posterior end. The genital primordia of 0·008–0·019 × 0·005–0·007 mm. in size was situated at 0·139–0·353 mm. distance in front of the posterior end behind the œsophageo-intestinal junction.

To determine the specific identity, numerous cysts were fed to a rabbit, a guinea-pig, a pigeon, a chick and a kitten. The kitten alone, on slaughter conducted on the 90th day of the infection, yielded adult specimens consisting of four males and 10 females. A large number of re-encysted forms were, however, recovered from the guinea-pig autopsied on 18th day of the infection—the location being the stomach wall. The juveniles were recovered after leaving the stomach in artificial gastric juice for digestion. These specimens resembled fully the infective stage administered.

The collection of the adult worms, after detailed study, was referable to *R. cahirensis* on account of the body dimensions and the morphology as described by Baylis.[2] The four male specimens, however, exhibited an additional pair of sessile papillæ on the anterior margin of cloaca. According to Baylis,[2] Jägerskiöld had described the anterior of the three pairs of the precloacal papillæ as pedunculated while Massino had stated them to be sessile. In our specimens, these papillæ were all pedunculated.

The role of the wall lizard as paratenic host of *R. cahirensis* has experimentally been demonstrated.

Grateful acknowledgement is due to the Indian Council of Agricultural Research for the award of a Senior Research Fellowship to one of the authors (V. P. G.).

Dept. of Parasitology, V. P. GUPTA.
U.P. College of Veterinary B. P. PANDE.
Science and Animal Husbandry,
Mathura (U.P.), *April* 28, 1970.

---

1. Alwar, V. S. and Lalitha, C. M., *Indian vet. J.*, 1958, **35**, 293.
2. Baylis, H. A., *The Fauna of British India Including Ceylon and Burma. Nematoda*, 1939, **2**, 274.
3. — and Daubney, R., *Rec. Indian Mus.*, 1923, **25**, 551.
4. Bhatia, B. B., Sood, S. M. and Pande, B. P., *Indian vet. J.*, 1959, **36**, 528.
5. Gupta, V. P., *M. V. Sc. Thesis*, Agra Univ., 1961.
6. Oswald, V. H., *Diss. Abstr.*, 1956, **16**, 1535.
7. —, *Trans. Am. microsc. Soc.*, 1958, **77**, 229.
8. Srivastava, H. D., *Indian J. vet. Sci.*, 1940, **10**, 113.
9. Swartz, L. G., *Diss. Abstr.*, 1959, **19**, 3063.

NATURAL INTERMEDIARIES AND PARATENIC HOSTS OF *SIMONDSIA PARADOXA*—AN IMPORTANT STOMACH WORM OF PIG

DURING our search for encysted nematode larvæ in several coprophagous beetles, lizards and birds, and in an insectivorous mammal, *Oniticellus pallens* Oliv. and *Onthophagus* sp. yielded, from the hæmocœl, numerous thin-walled and fragile cysts of 0·311–0·410 × 0·353–0·495 mm. diameter. A slight pressure of the needle on the coverslip preparation easily liberated the contained larva. The excysted juvenile, of 1·527–1·774 mm. length and 0·065–0·081 mm. in maximum breadth, had a long cylindrical buccal capsule of 0·078–0·113 mm.; an œsophagus in two parts—the short muscular of 0·097–0·113 mm. length and the long glandular of 0·426–0·506 mm. size; the nerve ring lying at 0·110·0–136 mm. distance and the excretory pore at 0·159–0·179 mm. behind the anterior end respectively; the 0·042–0·052 mm. long rectum surrounded by three unicellular rectal glands; 0·039–0·042 mm. long tail carrying at the tip a 0·003–0·005 × 0·006–0·010 mm. sized caudal papilla with nearly a dozen processes in two crowns—the outer series with larger processes; the genital primordia of 0·005–0·010 × 0·010–0·022 mm. size in the œsophageal region in female juveniles and in the intestinal region in male juveniles at 1·249–1·265 mm. and 0·565–0·622 mm. distance respectively in front of the posterior end.

Similar encysted larvæ were encountered in the gastric wall of *Hemidactylus flaviviridis* and *Crocidura cœrulea*. The extracted juveniles fully resembled the specimens from the coprophagous beetles.

Numerous cysts and excysted juveniles were administered to a white-leghorn chick, a pigeon, a guinea-pig, a rabbit and three piglets which were maintained in the laboratory under helminth-free conditions. The infective material from all the three sources was fed to three piglets. The insectan material was given to a rabbit. The cysts from the wall-lizard were fed to the other animals. In case of the rabbit autopsied on 20th day of infection, re-encystment was detected in the stomach wall which, on digestion with artificial gastric juice, yielded juveniles found identical to the infective stage administered. From the two piglets autopsied on 60th day of infection, two females (developed from the reptilian material) and a large number of males and females (developed from mammalian material) were collected. Though fully developed, the females did not contain embryonated eggs. From the third piglet, slaughtered on 70th day of infection, a large number of mature males and gravid females (developed from insectan material) were obtained.

Detailed study of the live specimens and of the fixed material after clearing revealed that the worms were clearly referable to *Simondsia paradoxa* Cobbold, 1864, recorded in our pigs.[1-4]

The recovery of fully-developed and mature specimens of *S. paradoxa* in experimental piglets infected from natural intermediaries and paratenic hosts is a significant addition to our existing knowledge on the biology of this important nematode. *Caccobius scheberi* in Bulgaria[6] and several scarabasids tenebrionids, carabids and histerids as its natural and experimental vectors in our country have been reported.[5]

Grateful acknowledgement is due to the Indian Council of Agricultural Research for the award of Senior Research Fellowship to one of us (V. P. G.).

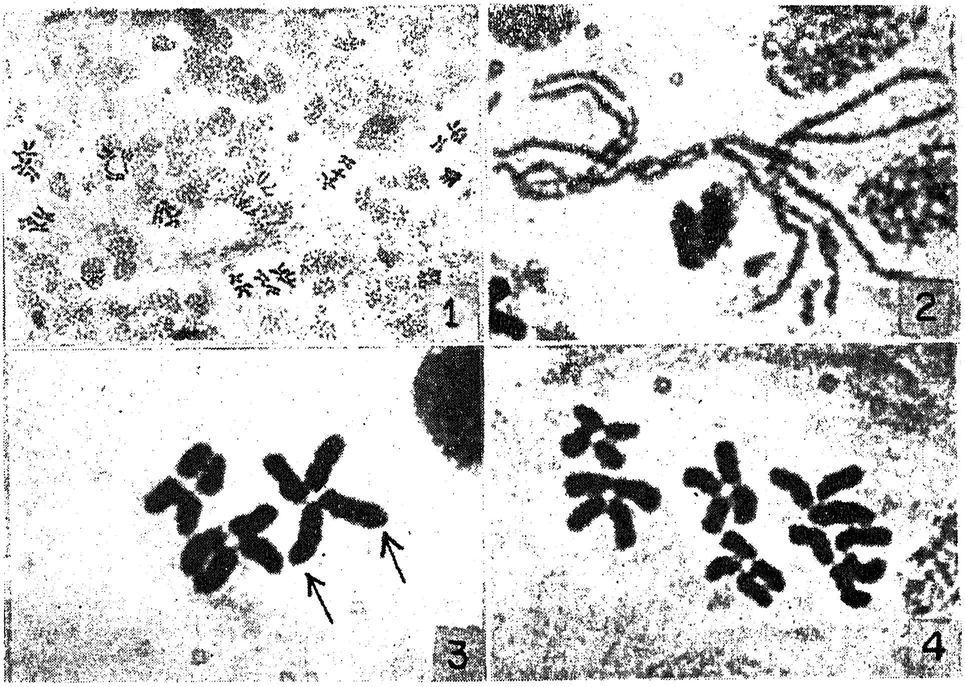
Dept. of Parasitology, V. P. GUPTA.
U.P. College of Veterinary B. P. PANDE.
Science and Animal Husbandry,
Mathura (U.P.), *April* 28, 1970.

---

1. Ahluwalia, S. S., *Indian J. Vet. Sci.*, 1960, **39**, 191.
2. Alwar, V. S., *Indian vet. J.*, 1958 **35**, 112.
3. Gupta, N. K. and Sood, M. L., *Proc. Indian Sci. Congr.*, Part III, Sec. 7, 1966, **53**, 347.
4. Ramanujachari, G. and Alwar, V. S., *Indian vet. J.*, 1953, **29**, 381.
5. Saxena, S. N., *Ph.D. Thesis*, Agra Univ. (Unpublished), 1966.
6. Trifnov, T., *Izv. tsent vet. Inst. Zaraz. Parasit. bol. Sof.*, 1962, **5**, 151.

KARYOTYPE OF *AEDES W-ALBUS*

STUDIES on the mitotic chromosome complements of various mosquito species have been reported by several workers.[1-10] The diploid chromosome number of all the mosquito species studied so far is six ($2n = 6$), except *Gorethra* sp. where the diploid chromosome number is 8 ($2n = 8$).[5] The purpose of the present communication is to record the mitotic chromosome complement of another mosquito *Aedes w-albus.*



FIGS. 1–4. Mitotic chromosomes from fourth-instar larval brain cells of *A. w-albus*. Fig. 1. Prophase and Metaphase chromosomes of diploid and polyploid cells, × 350. Fig. 2. Prophase chromosomes of a diploid cell, × 1,300. Fig. 3. Metaphase chromosomes of a diploid cell. The arrows show the longer arms of chromosome III, × 1,700. Fig. 4. Metaphase chromosomes of a polyploid cell, × 1,700.

To study the somatic chromosomes of this mosquito, the brain tissues from fourth-instar larvæ were used. The larvæ were from the laboratory colony of *A. w-albus*. The techniques employed for chromosome preparations were essentially the same as described by French *et al.*[11]

The karyotype of this species consists of three pairs of chromosomes (Figs. 1, 2, 3). The smallest pair (chromosome I), the intermediate pair (chromosome II), and the largest pair (chromosome III), measures 5·2, 6·5 and 8·2 microns respectively in late metaphase. Chromosomes I and II are metacentric, whereas chromosome III is submetacentric. The length of the two arms of the submetacentric chromosome III is 4·0 and 4·2 microns. The submetacentric character of chromosome III alone seems to be distinctive feature of this species. This character has not been observed in any other *Aedes* species studied so far. The somotic pairing in all the three pairs of chromosomes during prophase was intimate. Occasionally cells with polyploid chromosomes were also observed (Fig. 4).

The ratio of length between chromosome I, and chromosome II *plus* III in this species was found to be 0·353 which compared favourably with the ratio found in other members of the genus *Aedes*.[5,9]

Virus Research Centre, Poona, India, *June* 24, 1970.
K. R. P. SINGH.
U. K. M. BHAT.

---

1. Kitzmiller, J. B and French, W. L., *Amer. Zool.*, 1961, **1**, 366.
2. Breland, O. P., *Ann. Entomol. Soc. Amer.*, 1961, **54**, 360.
3. — and Gassner, G., *Texas. J. Sci.*, 1961, **13**, 391.
4. Rai, K. S., *Bull. Entomol. Soc. Amer.*, 1961, **7**, 174.

5. Rai, E. S., *Ann. Entomol. Soc. Amer.*, 1963, **56**, 160.
6. —, *Ibid.*, 1966, **59**, 242.
7. — and Craig. G. B., *Genetics.*, 1961, **46**, 891.
8. Akstein, E., *Bull. Res. Counc. Israel*, 1962, **9**, 146.
9. Mukherjee, A. B., Rees, D. M. and Vickery, R. K., *Mosquito News*, 1966, **26**, 150.
10. Baker, R. H. and Aslamkhan, M., *J. Med. Ent.*, 1969, **6**, 44.
11. French, W. L, Baker, R. H. and Kitzmiller, J. B., *Mosquito News*, 1962, **22**, 377.

OBSERVATIONS ON THE HATCHING OF FERTILIZED EGGS OF *HILSA ILISHA* (HAMILTON) IN CONFINED FRESHWATERS

EARLIER workers, who attempted artificial fecundation of *Hilsa ilisha* (Hamilton), carried out the hatching of fertilized eggs in McDonald jars,[2-6] wherein a continuous flow of water was maintained, on the presumption that flowing water was an absolute necessity. Recent work at this research centre[1] showed that muslin and markin cloth *hapas*, fixed in the river-bed close to the banks, were effective substitutes for McDonald jars. In the investigations carried out by us in 1969 at Sirsa near Allahabad on river Ganga, it was found that the riverine environment was not conducive for hatching as long as the index of visibility of the river-water, as determined by the Secchi's Disc, was 20 cm. or below. To circumvent such situations, attempts were made to ascertain the possibilities of hatching these eggs in *hapas* fixed in confined freshwaters, *viz.*, river pools and nursery ponds. The index of visibility during the investigation varied between 44 and 67 cm. in the pool and was 27 cm. in the nursery ponds (Table I).

Out of a total of 28 experiments, 17 were carried out in confined freshwaters and the rest in fluviatile environments. In the lentic environments, 14 experiments were carried out in a pool left behind in the sandy bed of the river Ganga by the receding monsoon floods and three in freshwater nursery ponds at Taraon Fish Farm. In all these experiments, markin and muslin cloth *hapas*, measuring 175 cm. in length, 80 cm. in breadth and 90 cm. in height and fixed in the bed of the pool at a place where the depth of the water was about 100 cm., were employed as containers for the fertilized eggs. The quantity of eggs released per *hapa* varied between 600 ml. (*c.* 1,80,000) and 800 ml. (*c.* 2,40,000).

The percentage of hatching varied between 5 and 80 in the river pool, being higher (25–80%) in experiments 1 to 6 (Table I). The temperature of the surface-water during the experiments ranged from 26·5–30·4° C., while the antagonistic ions of Ca fluctuated between 180 and 195 ppm. The pH ranged from 8·2–8·3, while the values of NO$_3$, PO$_4$, Fe and Cl fluctuated from 0·10–0·16, 0·07–0·08, 0·10–0·12 and 10–11 ppm respectively. Free CO$_2$ was absent throughout. During the latter experi-

TABLE I

Details of hatching the hilsa eggs in confined freshwaters

Sl. No.	Number of eggs in lakhs/% of fertilization	Hatching			Details			
		Duration in hrs./ percentage	Temperature (°C.)*	Sacchi's Disc reading (cm.)*	CO$_3$ (ppm)*	HCO$_3$ (ppm)*	Ca (ppm)*	DO (ppm)*
			(*a*) In river pool					
1	3·6/80	13·35/65·0	..	67	10	96	180	6·8
2	22·2/80	15·15/63·33	30·4/26·5	67/64	12/12	96/96	184/180	7·2/6·4
3	10·8/0	..	,,	,,	,,	,,	,,	,,
4	10·2/80	16·30/25·0	,,	,,	,,	,,	,,	,,
5	6·6/24	15·05/80·0	30·4/27·1	60/51	20/16	96/88	190/192	6·8/6·4
6	8·6/85	15·30/65·0	29·3/26·8	48/54	12/12	92/96	195/195	6·8/6·4
7	1·2/35	18·00/20·0	..	..	..	..	..	..
8	9·6/35	18·00/10·0	27·1/24·8	46/44	20/16	80/88	97/162	8·0/6·8
9	7·2/90	18·00/ 5·0	,,	,,	,,	,,	,,	,,
10	3·6/80	18·15/ 6·0	,,	,,	,,	,,	,,	,,
11	2·4/90	18·00/ 5·0	,,	,,	,,	,,	,,	,,
12	2·4/90	18·30/ 6·0	,,	,,	,,	,,	,,	,,
13	3·6/80	18·15/ 8·0	,,	,,	,,	,,	,,	,,
14	4·4/20	18·00/70·0	,,	,,	,,	,,	,,	,,
			(*b*) In nursery ponds					
1	18·0/—	20·00/20·0	26·8	27	8	100	125	6·4
2	9·6/—	20·15/15·0	..	..	..	..	..	..
3	8·4/—	17·00/30·0	28·4	27	12	104	162	8·0

* The numerator and denominator represent the values recorded at 18·00 hrs. and 6·00 hrs. respectively.

ments (7–14) when the temperature of the surface-water ranged from 24·8–27·1° C., pH 8·3–8·4, Ca 97–162 ppm, NO_3 trace to 0·06 ppm, PO_4 trace to 0·04 ppm, Fe trace to 0·05 ppm and Cl 10–11 ppm, the percentage of hatching was estimated to be between 5 and 20 only, with a single exception where the estimate was 70%.

In the nursery ponds, the percentage of hatching was estimated to vary between 15 and 30 (Table I). This low percentage of hatching in nursery ponds, as compared to those obtained in experiments 1–6 in the river pool, could be attributed probably to comparatively low water temperature in the ponds (26·8–28·4° C.), coupled with a comparatively low concentration of Ca (125 to 162 ppm). Low values of Ca and comparatively low temperature of the pool water during experiments 7 to 14, coupled with low magnitude of hatching, lends weight to the above assumption. The above successful hatching of fertilized eggs of hilsa, after artificial fecundation, in confined freshwaters was achieved for the first time.

Experiments to segregate the hatchlings from dead eggs and egg shells, employing 1/20", 1/24" and 1/28" meshed inner *hapa* in double-walled hatching *hapas*, did not give satisfactory results even in confined waters. Therefore, the hatchlings were segregated mechanically as in earlier experiments.[1]

Our thanks are due to Dr. V. G. Jhingran, Director, Central Inland Fisheries Research Institute, for his keen interest, helpful suggestions and encouragement during the progress of these investigations. Thanks are also due to Shri H. P. C. Shetty for his valuable suggestions and constant help, and to Dr. M. P. Motwani, Director of Fisheries, Government of Uttar Pradesh, for providing rearing facilities.

Central Inland Fisheries
Research Substation,
24, Panna Lal Road,
Allahabad-2 (U.P.),
August 17, 1970.

J. C. MALHOTRA.
P. K. MATHUR.
M. YUSUF KAMAL.
S. N. MEHROTRA.

---

1. Malhotra J. C., Mathur, P. K., Kamal, M. Yusuf, Chandra, Ravish and Desai, V. R., *Curr. Sci.*, 1969, **38** (18), 499.
2. Wilson, H. C., *Govt. of Madras*, *Revenue Dept.*, G.O 1219, 1909.
3. Raj, B. S., *J. and Proc. Asiat. Soc. Beng.*, 1917, **13**, 186.
4. —, *Madras Fish Bull.*, 1928, **22**, 1.
5. —, *Administrative Report of the Madras Fisheries Department for the Year 1934–35*, 1936, p. 74.
6. Dixitulu, J. V. H. and Chacko, P. I., *Fisheries Station Report and Year-Book*, Madras, 1962.

PURIFICATION OF THE SOUTHERN SANNHEMP MOSAIC VIRUS USING BUTANOL AND DIFFERENTIAL CENTRIFUGATION

SOUTHERN sannhemp mosaic virus (SSMV), a strain of tobacco mosaic virus (TMV),[2] has been found to be commonly occurring at Delhi.[3] The virus was purified earlier using ammonium sulphate and acid precipitation method by Anand[1] and the electron micrographs revealed the particles to be rod-shaped, resembling TMV. However, the size of viral particles was not calculated for comparison. The present paper deals with the purification of the virus using phosphate buffer with thioglycollic acid and butanol for initial clarification followed by differential centrifugation which yielded a highly concentrated purified preparation in the shortest time for electron microscopy, serological work as well as for density gradient centrifugation.

About 60 gm. of sannhemp leaves from mosaic-affected plants were minced in a waring blender with 1·5 × wt./volume of M/20 phosphate buffer (pH 7·6) containing 0·1% thioglycollic acid. The pulp was expressed through a double layer muslin cloth and to the juice N-butanol at 8·5% was added drop by drop with continuous shaking. The mixture was stored overnight in a frigidaire at 6° C. Next morning it was centrifuged for 25 minutes at 12,500 r.p.m. in a Spinco R. 30 rotor in a preparative ultracentrifuge model L (Spinco) to remove the extraneous plant material. The supernatant was passed through Whatman filter-paper No. 1 to remove the suspended impurities and then centrifuged at high speed at 30,000 r.p.m. in Spinco R. 30 rotor for 120 minutes to pellet the virus. The pellet, which was glossy and colourless, was suspended in a small quantity (0·5 ml. per R. 30 tube) of 0·01 M ammonium acetate buffer (pH 7·0). The virus suspension was finally centrifuged at 5,000 r.p.m. for 15 minutes to remove the suspended impurities.

For electron microscopy, the virus suspension was mounted on formvar-coated electron microscope grids (copper grades) and allowed to dry. The grids were shadow cast with gold palladium alloy and examined in Philips electron microscope model Em-100. The electron micrographs (Fig. 1) revealed the virus particles to be rod-shaped with a modal length of 300 mμ and an average diameter of 18 mμ.

The antiserum of the virus was prepared by injecting a rabbit intramuscularly with 1 ml, of the purified virus preparation suspended in saline emulsified with equal quantity of Freund's adjuvant (Bacto) complete thrice at weekly intervals followed by one intravenous injection of 1 ml. of the purified virus preparation alone in the marginal vein of the ear and bleeding the rabbit after ten days after the last injection. The blood was allowed to clot at room temperature (35° C.) for four hours and then stored overnight in a frigidaire. The serum was decanted off and centrifuged at 7,000 r.p.m. for 15 minutes to separate the suspended red blood cells. The antiserum was preserved in 50% glycerol and stored in a refrigerator.

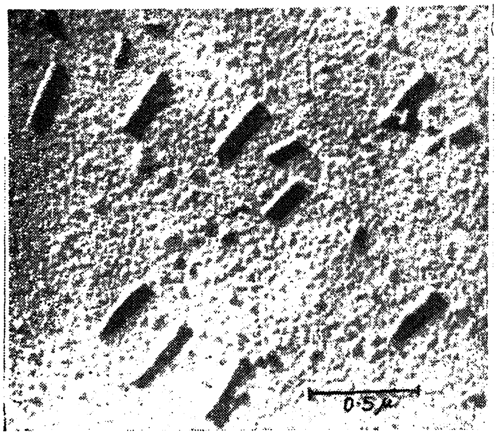


FIG. 1. Electron micrograph of SSMV particles, ×30,000.

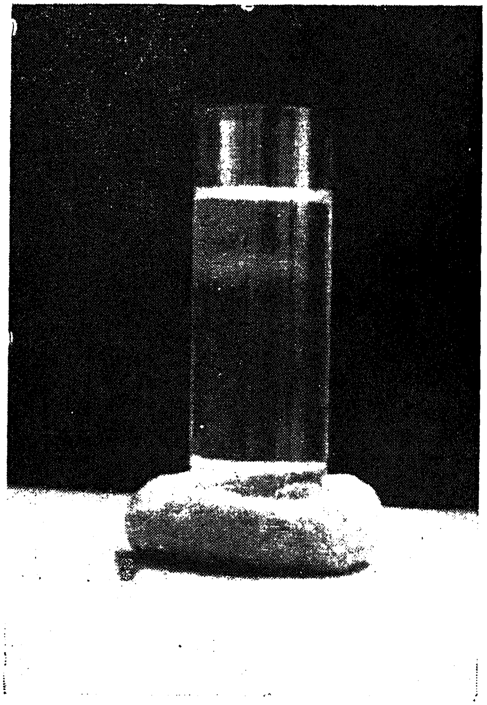


FIG. 2. Density gradient zone of SSMV in sucrose gradient columns.

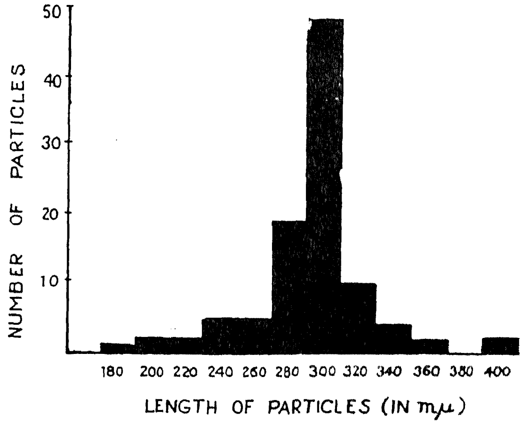


FIG. 3. Length distribution of SSMV particles.

The antiserum when tested against the purified virus preparation as well as the clarified diseased sannhemp plant sap gave specific precipitin reaction within 15 minutes with a precipitate of flagellar type typical of rod-shaped viruses but gave no reaction with healthy plant sap. The antiserum had a titre of 1 : 1024 when tested with the purified virus preparation and gave positive precipitin reaction with tobacco mosaic virus.

For density gradient centrifugation, the purified virus preparation was layered on the top of the sucrose density gradient columns (5, 8, 8, 8 ml., respectively, of 10, 20, 30 and 40% solution) in 3 × 1 inch cellulose nitrate tubes and centrifuged at 25,000 r.p.m. in Spinco swinging bucket R. 25 rotor for 30 minutes. A specific bluish light scattering zone was obtained which was observed by illuminating the gradient column in a dark room by a narrow beam of light passing into the tube from above. The samples taken from the zone were found to be highly infective and serologically active whereas those from above and below the zone were non-infective.

The authors are grateful to Dr. S. P. Raychaudhuri, Head of the Division of Mycology and Plant Pathology, for his keen interest and providing necessary facilities.

Division of Mycology
and Plant Pathology,
Indian Agricultural
Research Institute,
New Delhi-12, August 13, 1970.

T. K. NARIANI.
K. K. KARTHA.
NAM PRAKASH.

1. Anand, G. P. S., *Curr. Sci.*, 1968, **37**, 706.
2. Capoor, S. P., *Phytopathology*, 1962, **52**, 393.
3. Raychaudhuri, S. P., Nariani, T. K. and Das, C. R., *Indian Phytopath.*, 1962, **15**, 79.

TWO NEW LEAF-SPOT DISEASES OF BRINJAL (*SOLANUM MELONGENA* L.)

DURING a survey of vegetable crops in the months of October and November, 1968, two different types of leaf-spot diseases of brinjal were observed in the vegetable plots of the Horticultural Division, I.A.R.I., New Delhi. Isolations from the surface-sterilized leaf-spots in one case yielded pure culture of a species of *Helminthosporium* while in the other, a *Curvularia* species was detected. None of the species of *Helminthosporium* and *Curvularia* have so far been reported on brinjal. Studies were, therefore, initiated in respect of the symptoms they cause and the identification of the species of fungi responsible for these diseases. The results of these investigations are reported herein.

1. *Helminthosporium leaf-spot.*—The disease appears in nature as small irregular light brown spots on the affected leaves. These spots gradually enlarge in size and become circular to oval or irregular in shape with a dark-coloured boundary. The spots on the upper surface of the leaves are very prominent and are generally present in the interveinal areas. The mature spots are dark-brown and usually measure from 1-2 cm. in diameter. As the disease advances, some of the spots coalesce to form bigger ones. The older spots become thin and papery in the centre (Fig. 1).

The colony colour on the potato-dextrose-agar is dark olive-gray in the early stage of its growth which becomes olivaceous black with age. The mycelium is septate, profusely branched and measures 3-7 μ in diameter. Conidiophores are dark olivaceous to brown, irregular, simple, septa 7-48 μ apart. The conidia are chiefly 4-celled, borne in clusters, dark olivaceous to brown, straight, elongated and elliptical tapering towards the rounded ends and measure $24 \cdot 48\text{-}44 \cdot 37 \times 9 \cdot 18\text{-}15 \cdot 3\ \mu$, average being $32 \cdot 60 \times 11 \cdot 8\ \mu$.

The pathogenicity was proved by inoculating 4-week-old brinjal plants (variety Pusa purple long) by spraying the spore suspension on the test plants in the glass-house. The typical leaf-spots were developed a week after inoculation. On re-isolation, these spots yielded the same fungus.

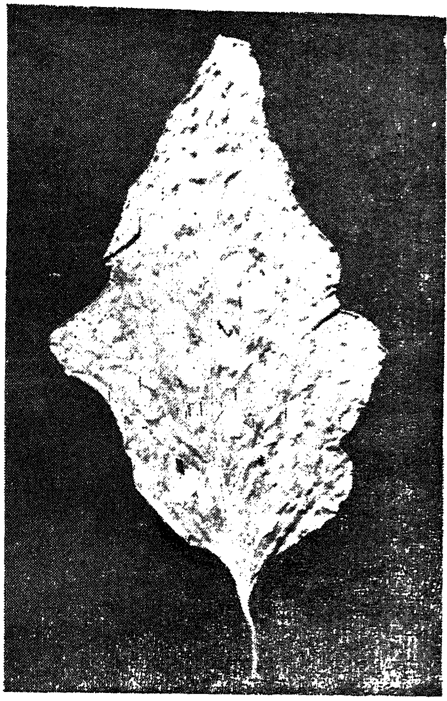


FIG. 1. Brinjal leaf showing leaf-spot symptoms caused by *Helminthosporium spiciferum* (Bain) Nicot.

The fungus was identified as *Helminthosporium spiciferum* (Bain) Nicot. Its culture has been deposited in the CBS Collection Baarn (Netherlands) under the accession number CBS 369.70. *H. spiciferum* has been reported on Bermuda grass by Gudauskas (1962) and on *Celosia cristata* L. by Prasad and Sinha (1963).

2. *Curvularia leaf-spot.*—The disease symptoms appear in nature as small, irregular brown spots on the leaves which turn dull dark-brown with age. The spots are scattered all over the leaf lamina and are mostly restricted to the interveinal areas. With infection, the interveinal areas also become chlorotic and the severely affected plants then show general chlorosis. In advance stages of infection the lesions coalesce involving bigger leaf areas. The blackish powdery mass of fungal spores protrude out from these spots which are clearly visible to the naked eye (Fig. 2). Ultimately the leaves become blighted which results in defoliation.

On potato-dextrose-agar, the colony of the fungus was floccos, brown to blackish-brown or black in colour. Mycelium is septate, irregularly branched, pale-brown to brown and 3 to 5·5 μ thick. The conidiophores arise singly or in groups, borne terminally and laterally on the hyphæ which are simple or branched, straight or flexuous, often geniculate, septate, pale-brown to brown, measures upto 450 μ in length and 3-6 μ in diameter. The conidia are acropleurogenous, straight or curved, ellipsoidal, obovoid or clavate, pale brown, 3-septate, the third cell from the base being frequently larger and darker than the others; the cell at each end is usually pale-brown and measures 21·42-30·60 × 9·18-15·30 μ, the average being 26·34 × 11·00 μ.

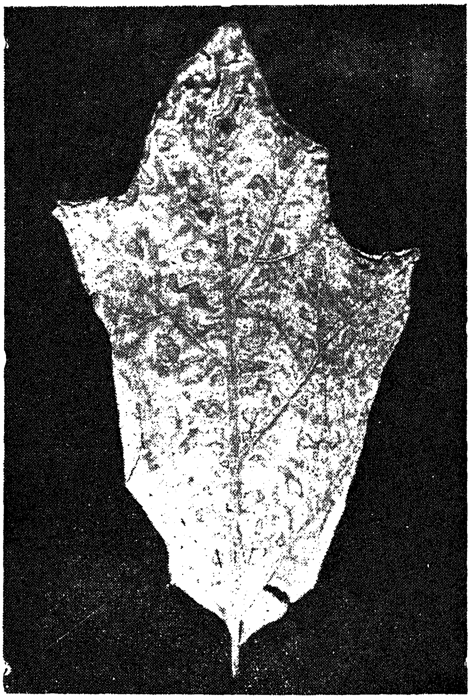


FIG. 2. Brinjal leaf showing leaf-spot symptoms caused by *Curvularia lunata* (Wakker) Boed.

The pathogenicity was proved by spraying spore suspension on the brinjal plants (variety Pusa purple long) in the glass-house. Typical leaf-spotting was developed and on re-isolation, these spots yielded the same species of *Curvularia*.

The fungus was identified as *Curvularia lunata* (Wakker) Boed. (Groves and Skolko, **1945**; Ellis, 1966). *C. lunata* has been reported as a parasite of certain solanaceous hosts, such as potato (Brown, 1957); tomato fruits (Tandon and Kakkar, 1964); and on fruits of *Capsicum annuum* (Rao, 1965). However, this is the first record of its occurrence on brinjal leaves.

The authors are thankful to Dr. J. A. von Arx, Director, Centraalbureau Voor Schimmelcultures Oosterstraat 1, Baarn (Netherlands), for help in identification, and to Dr. B. Choudhury, Head of the Division of Horticulture, I.A.R.I., New Delhi, for his co-operation. Thanks are also due to the PL 480 authorities for supporting the project financially.

Division of Mycology and D. V. SINGH.
Plant Pathology, S. P. RAYCHAUDHURI.
Ind. Agric. Res. Inst., M. L. SETH.
New Delhi-12, *July* 25, 1970.

---

1. Brown, L. R., *Biol. Exp. agrotec. Lima.*, 1957, **6**, **12.**
2. Ellis. M. B., *Mycol. Pap. No. 106*, 1966, p. 33.
3. Groves, J W. and Skolko, A. J., *Cand. J. Res.*, Sec. C, **1945**, **23**, **94**.
4. Gudauskas, R T., *Plant Dis Reptr.*, 1962, **46**, 498.
5. Prasad, S. S. and Sinha, B. D., *Curr. Sci.*, 1963, **32**, 517.
6, Rao, V. G., *Mycopath. Myco. Appl.*, 1965, **27**, 49.
7. Tandon, R. N. and Kakkar, R. K., *Naturwissenschaften*, **1964**, **51**, 297.

A NOTE ON A RADIO-RESISTANT AUXOTROPHIC STRAIN OF *RHIZOBIUM LEGUMINOSARUM*

RECOMBINATION of antibiotic-resistant and sensitive markers in *R. leguminosarum* was earlier reported.[1] During the studies on the induction of radio-resistance in this bacterium, using the cyclic irradiation technique,[3] a number of radio-resistant mutants were obtained, of which about 8% from the fourteenth cycle of irradiation were found to be auxotrophs. The present communication describes the level of radio-resistance and the essential requirement of a radio-resistant auxotrophic strain, R 14/1, of *R. leguminosarum*.

For cyclic irradiation, a tube containing 10 ml. of yeast extract-mannitol (YEM) broth was inoculated with a 24 hr. old culture of *R. leguminosarum* at 30° C. Of this culture, 1 ml. was added to 9 ml. of fresh broth and a portion of it was plated out to determine the initial cell concentration. The remainder was irradiated by a Hanovia mercury-vapour germicidal source (2537 Å) at a distance of 40 cm. for 2 sec. This was expected to reduce the concentration of cells by 50%. After irradiation, a portion was taken for counting survivors and 1 ml. of the remaining irradiated culture was diluted 10 times and incubated for 24 hr. at 30° C. This procedure was repeated through 14 irradiation-subculture cycles.

Strain R 14/1, isolated from the fourteenth cycle of irradiation, failed to grow in YEM medium even after prolonged incubation and also in the medium supplemented with four bases and nine growth factors, either singly or in combination. Of the twenty-four amino-acids tested, this strain was found to require alanine, which was, however, substitutable with cysteine (Table I).

TABLE I

Amino-acid requirement of the radio-resistant auxotrophic strain (R 14/1) *of* R. leguminosarum (*Period of incubation* 72 *hr. at* 30° *C.*)

		Growth (O D. at 680 nm)
YEM medium	..	0
DL-α-alanine (2 mg/ml)	..	0·19
L-cysteine (2 mg/ml)	..	0·12
Alanine+cysteine	..	0·3

Figure 1 shows a linear survival curve for the wild strain, whereas with the R 14/1 strain, a conspicuous upward shift in the survival curve could be seen. Under the present experimental conditions, R 14/1 was found to be radio-resistant upto an exposure level of 4 sec. (ca 100% survival). The LD_{50} exposure dose for the wild strain was 2·6 sec. and for the R 14/1 strain, 6·2 sec. (Fig. 1).

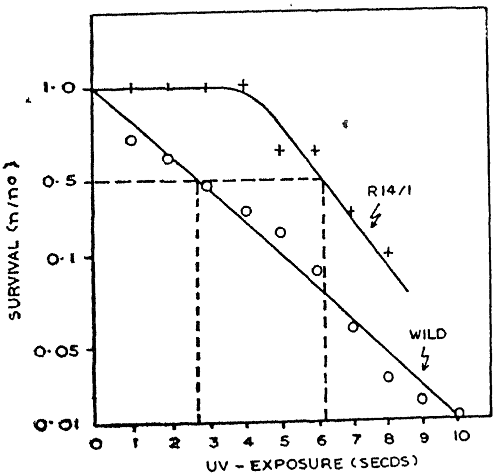


FIG. 1. Survival curves of the wild and radio-resistant (R 14/1) strains of *R. leguminosarum.*

The electronmicrographs show that the cells of the radio-resistant R 14/1 strain were about one-and-a-half times as big as those of the wild strain (Fig. 2). Radio-resistant mutants of such enlarged size are known in *E. coli*[2,4] and in *Salmonella.*[3]

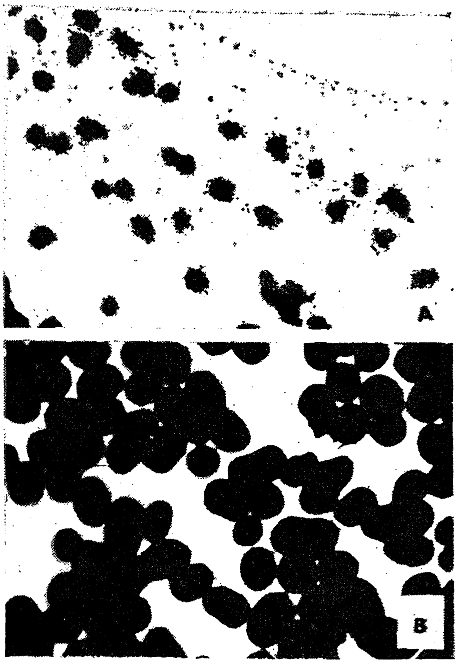


FIG. 2. Electronmicrographs of wild (A) and radio-resistant (R 14/1) (B) strains of *R. leguminosarum*, × 4,850.

Our thanks are due to the Head of the Division of Microbiology for his interest, and to Shri S. C. Mehta for kindly taking the electronmicrographs.

Division of Microbiol., PAROMITA BOSE.
I.A.R.I., New Delhi-12, G. S. VENKATARAMAN.
August 17, 1970.

---

1. Bose P. and Venkataraman, G. S., *Experentia*, 1969, **25**, 772.
2. Idziak, E K and Thatcher, F. S., *Can. J. Microbiol.*, 1964, **10**, 683.
3. Licciardello, J. J., Nickerson. J. T. R., Goldblith, S. A, Shannon, C. A. and Bishop, W. W., *Appl. Microbiol.*, 1969, **18**, 24.
4. Zelle. M. R. and Ogg, J. E., *J. Bacteriol.*, 1957, **74**, 485.

A NOTE ON THE INHERITANCE OF BETACAROTENE CONTENT IN *SORGHUM*

GRAIN *Sorghums* constitute a large portion of human diet in India and Africa. They are predominantly used for cattle and poultry feed in other countries. Most commercial varieties and hybrids available possess white endosperm in which carotene is absent. Vitamin A deficiency is seen in new-born babies, sometimes to the extent of born blindness if mother's diet constitutes *Sorghum* without supplementation. The discovery of yellow endosperm grain *Sorghums* in Nigeria enables incorporation of carotene, the precursor of vitamin A, in the varieties and hybrids of *Sorghum* grown extensively.

Blessin, Van Etten and Wiebe[1] reported that *Sorghums* originating from crosses made with African yellow endosperm varieties contained carotenoids as high as 8 to 9 ppm. The major carotenoids present were identified as lutein, zeaxanthin and β-carotene. Worzella, Khalidy, Badawi and Daghir[3] studied the inheritance of β-carotene content in the grain of eight *Sorghum* crosses. The betacarotene in the grain of the parents varied from 0·22 to an average of 3·23 milligrams per kilogram. The F_2 segregates generally fell between the parental limits. However, there was a preponderance of segregates with a β-carotene content lower than the mid-parent value. They concluded that relatively few genes are involved in the inheritance of β-carotene content in grain *Sorghum*. In the present study, an attempt is made to determine the type of gene action for total yellow pigment content in grain *Sorghum* from crosses between strains varying widely for this character.

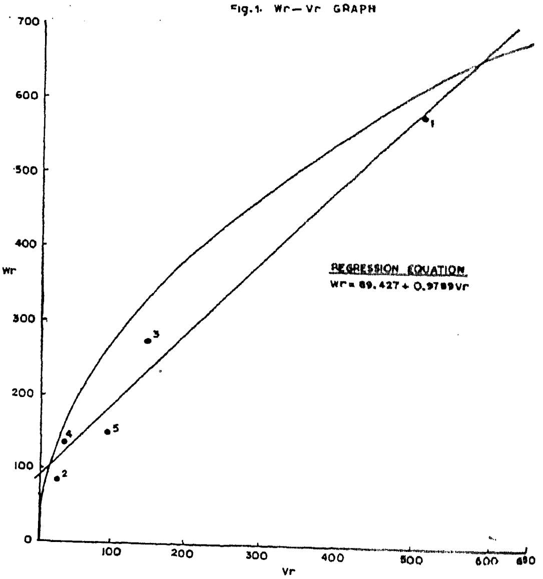
A full diallel set of crosses was made between five inbred lines of *Sorghum* which varied for total yellow pigments. Parents were chosen on the basis of appearance of endosperm colour. The parents and F_1 hybrids were sown in summer 1968 at IARI Regional Research Centre, Rajendranagar, in single rows. The individual plant was considered as single replication. Each analysis in each replication is based on three samples. Since it is known that there is a high correlation between β-carotene content and total yellow pigments, estimation of total yellow pigments was taken as a criterion for β-carotene content. The F_2 seeds from each of the F_1 hybrids and parental selfed seeds were analysed for total yellow pigments. Yellow pigments from 2 gm. of powder of grains were extracted by petroleum ether + acetone mixture (1 : 1) for 18 hr. in the dark and the filtrate (volume made upto 10 ml. by adding petroleum ether + acetone mixture) was read in Klett Summerson's photoelectric colorimeter using blue filter. Graphical analysis of the data as suggested by Jinks[2] was attempted.

Average colorimeter readings for total yellow pigments in 2 gm. of grains of selfed seed of parents and F_1 hybrids are presented in Table I and the Vr-Wr graphs in Fig. 1.

TABLE I

Parents	IS 511	IS 1601-B	IS 3691	IS 8622	IS 85 (11)
IS 511 ..	79·5	23·5	38·3	25·7	39·7
IS 1601-B ..		18·7	20·0	17·0	29·3
IS 3691 ..			24·8	13·5	41·5
IS 8622 ..				11·7	24·7
IS 84 (11)					48·5

Fig. 1. Wr—Vr GRAPH



The distances between the points on the graph indicate that there is substantial genetic diversity among the parents. The regression line has a slope of approximately one ($b = 0·9789$) indicating that the gene effects are of the additive type without much interaction. The interception of the regression line shows absence of dominance. The results suggest that selection for β-carotene content could be highly effective, and lines with pro-vitamin A activity, which could be of significance in human as well as in animal nutrition, could be isolated.

The authors are thankful to the Director, Nutrition Research Laboratory, Hyderabad, for providing facilities for chemical analysis.

IARI Regional Res. Station, Rajendranagar, Hyderabad-30, *August* 19, 1970.
D. L. SINGHANIA.
N. G. P. RAO.
L. R. HOUSE.

---

1. Blessin, C. W., Van Etten, C. H. and Wiebe, *Cereal Chem.*, 1958, **35**, 359.
2. Jankas, J. L., *Genetics*, 1954, **39**, 767.
3. Worzella, W. W., Khalidy, R., Badawi, Y. and Daghir, S., *Crop. Sci.*, 1965, **5**, 591.

AN INSTANCE OF THE OCCURRENCE OF *CONCHODERMA VIRGATUM* (SPENGLER) ON *LERNAEENICUS HEMIRHAMPHI* KIRTISINGHE

Conchoderma virgatum is a cosmopolitan species of pedunculate cirripede epizoic on copepods of the genus *Pennella*[1] and also rarely attaching directly to fishes like *Tylosurus acus*,[2] *Diodon hystrix*,[3,4] species of *Mola*, *Gymnothorax favagineus*,[5] *Remora remora*, and *Istiophorus orientalis*.[6] There seems to be no record of this interesting cirripede attaching on to *Lernaeenicus hemirhamphi*, a very destructive parasite infesting the genus *Hemirhamphus* along the coasts of India.

From a collection of 178 specimens of *Hemirhamphus xanthopterus*, 532 specimens of *Lernaeenicus hemirhamphi* were removed of which seven were found to be infested with *Conchoderma virgatum*. The infestation was not severe since only eight cirripedes could be collected. The nature of distribution of *Conchoderma virgatum* on the host was as follows: Two young specimens were attached close to each other on the genital segment near the base of the two egg strings, two others were found attached to the abdomen of the copepod while the remaining four were large adults cementing on to the genital segment almost occluding the genital opening (Fig. 1). The effect of this occlusion was particularly noteworthy in that there were no egg strings in these females.

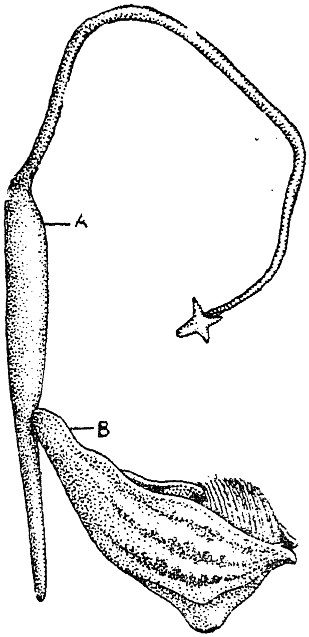


FIG. 1. *Lernaeenicus hemirhamphi* (A) infested by *Conchoderma virgatum* (B).

The region of attachment of the cirripede on to the body of the parasitic host showed indications of slight inflammation. Also one of the two specimens attaching to the genital segment had punctured the substratum with the result a part of the alimentary canal of the host has come out through the opening. These effects give an indication of the possible damage these epizoic forms are capable of inflicting on the host.

Marine Biological Lab., University of Kerala, Trivandrum-7, *August* 4, 1970.
P. NATARAJAN.
N. BALAKRISHNAN NAIR.

---

1. Daniel, A., *Bull. Mad. govt. Mus. nat. Hist.*, 1955, **6**, **1**.
2. Sumner, F. B., Osburn, R. C. and Cole, L. J., *Bull. U.S. Bur. Fish.*, 1913, **31**, 245
3. Crozier, L. J., *Amer. Natural.*, 1916, **50**, 636.
4. Balakrishnan, K. P., *Crustaceana*, 1969, **16**, 101.
5. Ciurea, J., Monod, T. and Dinulesco, G., *Bull. Inst. Oceanogr. Monaco.*, 1913, **615**, 1.
6. Jones, E. C., Rothschild, B. J. and Shomura, R. S., *Crustaceana*, 1968, **14**, 194.

REVIEWS AND NOTICES OF BOOKS

Relativity. Edited by Moshe Carmeli, Stuart I, Fickler and Louis Witten. (Plenum Press, New York and London), 1970. Pp. xii + 381. Price $ 20.00.

Since Einstein proposed his theory of general relativity, physicists and mathematicians have been profoundly concerned with experiments designed to provide empirical confirmation. This research has frequently introduced new and previously unconsidered factors and has served to extend the theory beyond its original boundaries. Much of the recent work has concentrated on the theory's cosmological and gravitational implications.

Both those aspects and all other major areas of importance in today's relativity research are examined in this volume. The extensively reviewed and critically weighed topics include: Dynamics of the Gravitational Field; Cosmological Models; Experimental Tests of General Relativity; Quantization of the Gravitational Field; Relativistic Kinetic Theory; and The Philosophical Foundations of General Relativity.

The section on "superspace", a new, geometrical approach to the theory of general relativity, offers the first organized presentation of a theory believed to be a major advance in relativity research. C. V. R.

Mossbauer Effect Methodology, Vol. 5. Edited by Irwin J. Gruverman. (Plenum Publishing Corporation, 114, Fifth Ave., New York, N.Y. 10011, U.S.A., and Donington House, 30 Norfolk Street, London, W.C. 2), 1970. Pp. viii + 278. Price $ 19.50.

This is the fifth volume of a series which provides a continuing forum for publication of development in Mossbauer effect methodology and of spectroscopy and its applications.

Mossbauer Effect Methodology. Volume 5, records the proceedings of the Fifth Symposium on Mossbauer Effect Methodology. The symposium was sponsored by the New England Nuclear Corporation and was centered on the themes of spectroscopy, new applications, and methodology. The symposium was held in the Mercury Ballroom of the New York Hilton Hotel on February 2, 1969. Dr. P. A. Flinn of Carnegie-Mellon Institute was chairman of the afternoon and evening sessions. About three hundred participants attended, and a sixth symposium is anticipated early in 1970.

This volume under review is divided into three areas of study: spectroscopy, new applications, and methodology. Under these general headings internationally recognized experts report on their research in environmental control, techniques for measuring radioactive materials, and applications to metallurgy, mineralogy, and biology. This book will be found useful by the growing number of chemists, physicists, and technologists who are becoming interested in this rapidly developing field.

C. V. R.

ERRATUM

Curr. Sci., 1970, 39, November 20 issue, page 507, name of the author, *for* Muralidharan, *read* Muralirangan.

Books Received

Reviews of Plasma Physics. Edited by Acad. M. A. Leontovich. (Plenum Publishing Corporation, New York 10011), 1970. Pp. xiv + 525. Price $ 25.00.

Marine Chemistry (Vol. 2) *Theory and Applications.* By D. F. Martin. (Marcel Dekker, Inc., New York 10016), 1970. Pp. xi + 451. Price $ 9.50.

Advances in X-ray Analysis (Vol. 13). Edited by B. L. Henke, J. B. Newkirk and G. R. Mallett. (Plenum Publishing Corporation, New York 10011, N.Y.), 1970. Pp. xii + 681. Price $ 5.00.

Magnetic Resonance. Edited by C. K. Cogan, N. S. Ham, S. N. Stuart, J. R. Pilbrow and G. W. H. Wilson. (Plenum Publishing Corporation, New York, N.Y. 10011), 1970. Pp. xii + 386. Price $ 16.00.

Protein Metabolism of the Nervous System. Edited by Abel Lajtha. (Plenum Publishing Corporation, New York 10011, N.Y.), 1970. Pp. xxi + 732. Price $ 45.00.

NMR Spectroscopy in Organic Chemistry. By B. I. Ionin and B. A. Ershov. (Plenum Publishing Corporation, New York 10011, N.Y.), 1970. Pp. x + 382. Price $ 25.00.

2411-70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, L.P.T., Superintendent, at The Bangalore Press, Bangalore-18.

Sir C. V. Raman has been President of the Current Science Association till his death on November 21, 1970. He has built up *Current Science* into being the premier science fortnightly of India and the journal may be regarded by the Scientific Community as a great legacy which he has left behind him. I appeal to all scientists in the country to lend their support and do what lies in their power to enable this Fortnightly Journal of Research grow in strength and reach excellence which was the cherished goal of our distinguished past President, Sir C. V. Raman. This is the best way in which we can pay homage to the great Scientist which India has produced.

S. BHAGAVANTAM,
President, Current Science Association.

BANGALORE,
December 7, 1970.

ON THE ESTIMATION OF OXIDE/METAL INTERFACIAL ENERGY BY INTERNAL OXIDATION

SATEESH H. GHUDE* AND C. M. SELLARS**

INTRODUCTION

INTERNAL oxidation is a solid/gas phase reaction in which the stable oxide of a solute metal of high oxygen affinity is precipitated in the matrix of a relatively noble metal by exposing the alloy to a mildly oxidizing atmosphere. The precipitation of the oxide particles occurs uniformly throughout the matrix. Among the various systems studied (such as Ag-Cd,[1] Cu-Al,[2], Cu-Be,[3] Cu-Cr,[4] Cu-Si,[4] Cu-Ti,[4] Ni-Al,[5] etc.), the precipitate oxide particles have been found to be invariably crystalline excepting in Cu-Si alloy where they have been found to be amorphous in nature. The particles precipitated at the grain boundaries have usually the same shape as the one precipitated within the grains except that occasionally they are slightly bigger in the direction of the grain boundary as illustrated in Fig. 1 for Cu–Mg alloy. However, in case of Cu-Ti and Cu-Si alloys, the grain boundary particles have been reported to assume the equilibrium shape which would be a double convex lens bounded by two spherical surfaces of the same radii.

The relationship between various energy terms involved for an equilibrium-shaped grain boundary particle is illustrated in Fig. 2. If the energy of the particle-matrix interface is independent of orientation of the grain boundary, the interfacial energy can be calculated by determining the equilibrium dihedral angle and using the following relationship given by Smith,[6]

$$2 \cos \frac{\theta}{2} = \frac{\gamma_{g.b.}}{\gamma_{pm}} \tag{1}$$

where,

θ is the equilibrium dihedral angle,

$\gamma_{g.b.}$ is the grain boundary energy, and

$\gamma_{p.m.}$ is the particle/matrix interfacial energy.

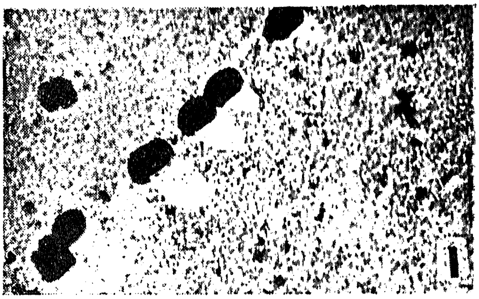
It is essential that true dihedral angles should be measured. If measurements are done on planar metallographic sections, statistical methods must be employed to estimate the correct dihedral angles. However, true dihedral angles can be measured directly, if thin foils of the specimens are used in transmission electron microscopy and care is taken to align the grain boundary parallel to the electron beam. The angles can be determined by a geometrical construction or by the following simple relationship, provided the two spherical surfaces bounding the particles have identical radii.

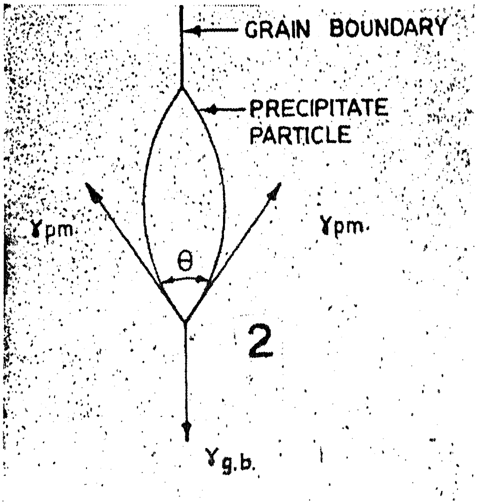
$$\cot \theta/4 = d/t \tag{2}$$

where,

d is the diameter of the lens-shaped particle, and

t is the thickness of the lens.





FIGS. 1–2. Fig 1 The grain boundary precipitation in Cu–Mg alloy internally oxidized at 800° C., × 28,000. Fig. 2 Relationship between grain boundary energy and particle-matrix interfacial energy for an equilibrium-shaped grain boundary particle.

EXPERIMENTAL

Copper-silicon alloys containing 0·12% and 0·25% silicon, and copper-magnesium alloy containing 0·21% magnesium were melted in

---

* Defence Metallurgical Research Laboratory, Hyderabad-23.

** Department of Metallurgy, University, Sheffield.

a high purity graphite crucible in a vacuum induction furnace under argon atmosphere. The alloys were vacuum cast into suitable ingots and then subsequently reduced to strips of about 1 mm. thickness by hot extrusion, cold rolling and intermediate vacuum annealing. OFHC copper and high purity silicon and magnesium were used for making the alloys.

For internal oxidation specimens of about 1 × 1 × 0·1 cm. size were packed in a mixture of alumina, cuprous oxide and copper powder in the ratio of 2 : 1 : 1 and annealed in argon atmosphere at the desired temperature for a predetermined time to effect complete internal oxidation throughout the section.[7] The copper/copper oxide mixture provides the necessary oxygen partial pressure for internal oxidation while alumina powder prevents the sintering of the mixture to the sample. The oxidized samples were cleaned with fine emery-paper and electropolished in a D-2 solution. Carbon extraction replicas from these samples were prepared in the usual manner. To obtain the thin foils, coupons about 3 mm. dia. were trepanned from the specimen by spark machining. They were then dished on both the sides by jet polishing in an electrolyte of 50% orthophosphoric acid and then subsequently polished in D-2 electrolyte until a small hole just appeared in the centre. Both replicas and the thin foils were examined at 100 KV in EM-6/JEM-7 electron microscope.

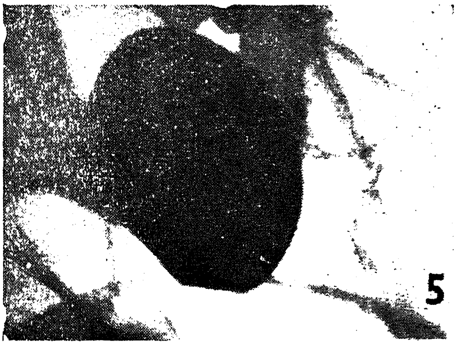
The dihedral angles were measured on the enlarged photographs by drawing tangents to the particles as well as by measuring the '*d*' and '*t*' values. A good agreement was obtained between both the values which indicates that the two faces bounding the particle have identical radii.

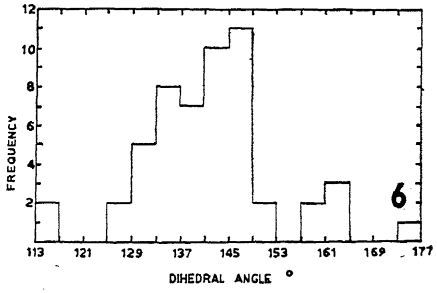
RESULTS

The typical photographs of the grain boundary precipitates are illustrated in Figs. 1, 3 and 4. The grain boundary particles of silica were invariably lenticular in shape. However, occasionally few faceted particles (Fig. 5) were also observed. The grain boundary particles of magnesia were slightly elongated in the direction of the grain boundary but apparently they did not assume the equilibrium shape and hence could not be used for estimation of interfacial energy.

Both replicas and thin foils were used to calculate the dihedral angles. While examining thin foils, care was taken to align the grain boundary parallel to the electron beam as judged by the thickness of the grain boundary. The

FIGS. 3–4. Fig. 3. Grain boundary precipitation in Internally oxidized Cu-Si alloy (Carbon extraction replica), × 5,000. Fig. 4. Grain boundary precipitation in internally oxidized Cu-Si alloy (thin foil), × 10,000.





FIGS. 5–6. Fig. 5. Faceted grain boundary particles of silica observed in Cu-Si alloy, × 34,000. Fig. 6. A typical distribution of dihedral angles observed in case of internally oxidized Cu-Si alloy.

results obtained from the replicas as well as thin foils were handled separately by statistical methods. However, since both the results yielded identical values for the dihedral angles, they were combined together in the final plot. Figure 6 shows a histogram for dihedral angles observed in Cu-0·25 Si alloy oxidized at 1,000° C. It is seen that most of the values for dihedral angles fell between 124° and 153° C. However, occasionally much lower or higher angles were also encountered.

To calculate the interfacial energy of copper-silica interface, the grain boundary energy of copper was assumed to be 600 ergs/cm^2.[8] The results for dihedral angles and calculated interfacial energies are summarized in Table I. The dihedral angle was found to be independent of the silicon content of the alloy and to increase slightly with decrease in the oxidation temperature. No significant precipitate-free zones adjacent to grain boundaries were observed.

TABLE I

Interfacial energy of Cu/SiO$_2$ interface

Alloy	Temperature of oxidation (°C.)	Dihedral angle	Interfacial energy ergs/cm.^{2}	Reference
Cu-0·25% Si ..	1000	142±3°	921	Present work
Cu-0·12% Si ..	1000	144°	971	,,
Cu-0·12% Si ..	800	147±3°	1056	,,
Cu-Si ..	800	152	1000-1200	Ashby and Smith[10]
Cu-0·3% Si ..	800	135	780	Palmer[11]
Cu-0·3% Si ..	1000	135	684	,,

DISCUSSION

Electron microscopic examination of the magnesia oxide particles in the matrix revealed that they were coherent with the matrix. A complete orientation relationship has been determined by Lewis.[9] A coherent interface suggests that the interfacial energy of copper-magnesia is probably very low.

The interfacial energy for copper-silica was found to be 950 ergs/cm.^{2} at 1,000° C. and 1,050 ergs/cm.^{2} at 800° C. Thus, interfacial energy shows a behaviour similar to that of surface energy of pure metals in that it decreases with increase in temperature.[8] However, the data are insufficient to estimate the temperature coefficient of the interfacial energy.

The above results are in good agreement with the earlier values reported by Ashby and Smith[10] for Cu/SiO$_2$ alloys. Palmer,[11] however, reported values of 680 and 780 ergs/cm.^{2} for temperatures of 1,000° C. and 800° C. respectively. The author chose the minimum values of dihedral angles to calculate the interfacial energy. This was ostensibly done to avoid any errors caused by the grain boundary being inclined to the electron beam. The procedure, however, does not seem to be justified because apart from the above variation caused by inclination of the grain boundary to the electron beam, there is a 'true' variation of the dihedral angle from particle to particle and grain boundary to grain boundary. The latter arising from the slight dependence of the dihedral angle on the misorientation across the grain boundary. Hence, statistical methods seem to be the best way of arriving at the correct estimate of the dihedral angle.

A much lower value of 564 ergs/cm.^{2} for copper-titania interfacial energy has been reported by Williams.[4] This was attributed by the author to the possible presence of certain impurities. However, Palmer[11] has subsequently shown that the presence of impurities affects the interfacial energy as well as the grain boundary energy to the same extent so that the dihedral angle remains unchanged. A more plausible explanation seems to be that the grain boundary titania particles do not assume the equilibrium shape because they are, unlike silica particles, crystalline in nature.

Interfacial energy is a measure of the binding force between the surfaces. The greater the interfacial energy, the smaller will be the work of separation required to rupture the interface. During plastic deformation, extensive cavitation occurs at the interface to relieve the stress concentration at the particles. The incidence of such a cavitation process, which may affect the final fracture, will, therefore, be related to the magnitude of the interfacial energy. Studies on interfacial energy would, thus, provide a good insight on the role of dispersed particles in the fracture of materials.

ACKNOWLEDGEMENT

The authors are grateful to Prof. A. G. Quarrell, Head of the Metallurgy Department, Sheffield University, for providing the facilities.

1. Bohm, G. and Kahlweit, M., *Acta Met.*, 1964, **12**, 641.
2. Wood, D. I., *Trans. A.I.M.E.*. 1965, **215**, 925.
3. Kimura, T. and Wantanabe, Y., *J. Jap. Met. Soc.*, 1965, **29**, 885.
4. Williams, D. M., *Ph.D. Thesis*, Cambridge Unirvesity, 1964.
5. Bonis, L. S. and Grant, N. J., *Trans. A.I.M.E.*, 1962, **224**, 308.
6. Smith, C. S., *Ibid.*, 1948, **175**, 15.
7. Rhines, F. N., *Ibid.*, 1964, **137**, 246.
8. Inman, M. C. and Tipler, H. E., *Met. Reviews*, 1963, **8**, 105.
9. Lewis, M. H., *D.Phil. Thesis*, Oxford University, 1963.
10. Ashby, M. F. and Smith, G. C., *J. Inst. Metals*, 1962, **91**, 182.
11. Palmer, I. G., *Ph.D. Thesis*, Cambridge University 1966.

STERILIZING EFFECT OF A DIETARY SURPLUS OF BIOTIN IN *TROGODERMA GRANARIUM* EVERTS

S. S. SEHGAL, HARI C. AGARWAL AND M. K. K. PILLAI
Department of Zoology, University of Delhi, Delhi-7

INTRODUCTION

INSECTS in general are known to require biotin in their diet for normal growth and development.[1] Recently, it has been shown in a few insect species that an excess of biotin in the diet causes reduction in their fertility.[2-5] It is of interest to know if biotin will elicit similar reactions in insects in general. Hence, such studies were conducted with Khapra beetle, *Trogoderma granarium* Everts, which is a serious pest of stored cereals.

MATERIALS AND METHODS

T. granarium were normally cultured on broken wheat and 5% brewer's yeast at 35 ± 1° C. and a relative humidity of 65% to 70%. For biotin treatment, a chemically defined diet was used.[6] Biotin was dissolved in 0·1 N sodium hydroxide and the known amounts added to the diet. The diet was allowed to equilibrate for 48 hours with the experimental conditions. One gm. diet was kept in a glass vial of 2·5 × 5·0 cm. In each vial, 20 ten-day-old larvae were introduced. Each treatment was replicated 10 to 12 times. The adults were removed from the diet soon after emergence and the period recorded. The males and females were separated and subsequently used for appropriate crosses. The diet containing only sodium hydroxide solution was used as controls. Additional controls using broken wheat flour and 5% brewer's yeast were also kept. Crosses were made between treated males and treated females, treated males and normal females and normal males and treated females. The eggs were scored at frequent intervals for ten days and allowed to hatch. The number of eggs hatched was also recorded.

RESULTS AND DISCUSSION

Higher doses of biotin, such as 0·5% and 1·0% inhibited further development of the larvae ultimately causing complete mortality. However, there was no mortality at the lower doses of biotin even upto 90 days of treatment. Higher levels of biotin treatment resulted in mortality in house-flies[3] and in *Aedes aegypti*.[5] *Dermestes maculatus*, a closely related species, however, was apparently able to tolerate upto 1% dietary biotin.[4] Comparison of toxicity based on such treatments may be taken with caution as it is possible that the amount of biotin uptake may vary in different cases as it is dependent on the period of treatment and the actual amount of food consumed by the insect. It is evident from Table I that the lower levels of biotin reduced the number of adult emergence. It was observed that this was due to a retarded development of the larvae. In all the treatments, the time taken for adult emergence increased with an increase in the biotin content of the diet (Table I). Such a growth inhibition was not recorded in other insect species studied.[2-5] The treatments in general reduced the fecundity, but the sodium hydroxide controls also showed a similar reduction. This will mean that the fecundity reduction may be due to sodium hydroxide treatment rather than the biotin overdosage. However, sodium hydroxide has been shown to have no effect on fecundity and fertility in house-flies.[3] Biotin did cause a reduction in the number of eggs laid in the insects studied so far.[2-5]

In *T. granarium*, the primary effect of biotin treatment was found to be on the fertility of eggs. A large number of eggs were sterile and

TABLE I

Effect of dietary biotin on the development, fecundity and fertility of T. granarium

Per cent conc.	No. of larvae treated	No. of adults emerged	No. of days for adult emergence		Sex treated	No. of pairs mated	Total no. of eggs laid	Eggs laid/ female	Total no. of eggs hatched	Per cent hatch
			Average	Range						
0·05	240	187	37·9	29–45	Male	34	332	9·8	238	71·7
					Female	29	275	9·5	99	36·0
					Both	55	396	7·2	149	37·6
0·10	240	162	40·3	30–53	Male	35	397	11·3	262	66·0
					Female	15	70	4·7	14	20·0
					Both	40	245	6·1	54	22·0
0·25	240	59	44·9	31–54	Male	18	314	17·4	169	53·8
					Female	..	..	..	..	..
					Both	11	57	5·2	4	7·0
Control (NaOH)	100	78	33·8	28–43	None	17	87	5·1	66	75·9
Control (Normal diet)	100	96	26·8*	22–32*	None	20	309	15·5	220	71·2

* Agarwal, 1970.

consequently did not hatch. At a biotin level of 0·05%, the sterility was about 62%. This increased to 93% at 0·25% biotin treatment. In the controls, more than 70% of the eggs hatched. This reduced fertility was due to an effect on the female only as can be seen in Table I. The per cent hatch of eggs in crosses between normal females and treated males were almost same as the controls. However, in the reciprocal crosses, the percentage of eggs hatching was identical to the crosses where both the males and females were treated. These results are in conformity with the ones reported so far[2-5] and it appears that induction of sterility may be a general effect of an overdose of biotin in insects. It will be of interest to know the physiological mechanisms involved in such a specific effect on the females.

The authors wish to thank Prof. B. R. Seshachar, Head of the Department of Zoology, University of Delhi, for facilities.

1. House, H. L., In *The Physiology of Insecta* (Ed. by Rockstein, M.), Academic Press, New York, 1965, **2**, 769.
2. Benschoter, C. A. and Paniagna, R. G., *Entomol. Soc. Amer.*, 1966, **59**, 298.
3. Benschoter, C. A., *J. Econ. Entomol.*, 1967, **60**, 1326.
4. Cohen, E. and Levinson, H. Z., *Experientia*, 1968, **24**, 367.
5. Pillai, M. K. K. and Madhukar, B. V. R., *Naturwissenschaften*, 1969, **56**, 218.
6. Agarwal, H. C., *J. Insect Physiol.*, 1970, **16**, 2023.

COMPARATIVE STUDIES ON THE DIFFERENT METHODS OF ARTIFICIAL RIPENING OF BANANA FRUITS

A. B. ABOU AZIZ AND F. K. ABD-EL-WAHAB

Fruit Physiology Laboratory, National Research Centre, Dokki, Cairo, U.A.R.

INTRODUCTION

BANANA fruits do not normally attain the ripening stage on the trees and so they are gathered to be ripened artificially. Various chemicals like ethylene, acetylene, coal gas and some growth-regulating substances are usually employed for artificial ripening of fleshy fruits. Banana fruits do not respond to ethylene treatment if they were previously treated with 2, 4-D.[7] The pulp/peel ratio of banana fruits treated with 2, 4-D and 2, 4, 5-T increased gradually until the ripeness condition is attained.[1-3] According to Abd-El-Wahab *et al.*,[1] the total soluble solids increased steadily during the artificial ripening of banana fruits treated with 2, 4-D and the increase began earlier in the treated than in the untreated fruits. The titrable acidity increased when the fruits reached the ripeness condition.[1,2] Kidd and West,[6] Gane,[4] Wardlow and Leonard,[9] working on the respiration of banana fruits, found that the low steady values of carbon dioxide production in the green stage raised sharply to a peak as, or just before, the first visible signs of ripening appeared, and then declined to a steady level, slightly higher than that found in the green fruits. The sharp rise in respiration rate attained a climacteric peak 2-5 times as great as the previous one.

The purpose of this work is to study the effect of various chemical substances, which are in common use at present, on the quality of banana fruits during the artificial ripening process.

MATERIALS AND METHODS

Mature branches of "Hindi" banana fruits (*Musa cavendishii* var. *cavendish*) gathered from the plants grown in Barrage were used in the present investigation. A set of three bunches was used for each treatment adopting the following procedure:

(1) In the case of control group, the bunches were dipped for 30 seconds in water.

(2) For treatment with 2, 4-D, the fruits were dipped for 30 seconds in an aqueous solution of this substance at a concentration of 1,000 ppm.

(3) For treatment with acetylene, the bunches were held for three days in a room with acetylene at the rate of 60 cc/cubic meter; the temperature was kept constant at 60-65° F.

(4) In the case of treatment with coal gas, the fruits were held for three days in a room with coal gas at the rate of one kg. of burning coal per 16 cubic meters of space. The temperature during treatment was also kept constant at 60-65° F.

Following all treatments, the fruits were kept in a room with a temperature ranging from 70-75° F.

Determination of some physical properties of the fruits such as color development, peeling and pulp/peel ratio as well as the chemical properties, such as total soluble solids, titrable acidity and respirational activity, was carried out at three-day interval.

RESULTS AND DISCUSSION

1. *Color Development.*—The visual color of banana fruits was estimated according to the color chart of von Loesechke.[8] The data in Table I show a gradual increase in the color development of banana fruits as they approached the ripening condition. This was true in both treated and untreated fruits. The rate of color development was more rapid in fruits treated with 2, 4-D, acetylene and coal gas than in the untreated ones. The fruits treated with 2, 4-D, acetylene or coal gas attained the yellow color (grade 3) after 9, 6 and 9 days respectively, as compared to 21 days in the untreated fruits. Although the 2, 4-D, acetylene or coal gas treatments has a similar trend in inducing the attractive color, the fruits treated with 2, 4-D have a longer marketing time than those treated with either acetylene or coal gas. The fruits treated with 2, 4-D, acetylene or coal gas attained the maximum color (grade 7), 18, 12 and 12 days after treatment respectively as compared to 30 days in the untreated fruits. These results are in agreement with those reported by Abd-El-Wahab and Abou Aziz.[1,2]

TABLE I

Effect of some chemical treatments on color development during the artificial ripening of banana fruits

Period of ripening (in days)	Grade No. after treatments			
	Control	2, 4-D	Acetylene	Coal gas
0	1	1	1	1
3	2	2	2	2
6	2	2	3	2
9	2	3	4	3
12	2	3	7	7
15	2	4		
18	2	7		
21	3			
24	3			
27	4			
30	7			

2. *Peeling Condition.*—The peeling of banana fruits is a good criterion for evaluating ripening. Data presented in Table II show that fruits were still hard peeling until the first sign of ripening took place. Untreated fruits and fruits treated with 2, 4-D, acetylene or coal gas reached the ripening condition at 27, 9, 6 and 6 days respectively. It may be pointed out that

TABLE II

Effect of some chemical treatments on the peeling condition during the artificial ripening of banana fruits

Period of ripening (in days)	Treatments			
	Control	2, 4-D	Acetylene	Coal gas
0	Unpeeling	Unpeeling	Unpeeling	Unpeeling
3	,,	,,	Hard peeling	Hard peeling
6	,,	Hard peeling	Peeling	Peeling
9	,,	Peeling	Easily peeling	,,
12	,,	,,	,,	Easily peeling
15	Hard peeling	Easily peeling		
18	,,	,,		
21	,,			
24	,,			
27	,,			
30	,,			

the trend of peeling did not coincide exactly with the color development during the ripening process. So, the color test is not a good criterion for the artificial ripening of banana fruits.

3. *Pulp/Peel Ratio.*—The pulp/peel ratio is affected by dehydration of the bananas. The peel loses water more easily than the pulp resulting in a modification of pulp/peel ratio during transport and artificial ripening. Data in Table III show that the pulp/peel ratio of banana fruits increased gradually until the fruits reached the over-ripe stage. This was true in both treated and untreated fruits. The treated fruits reflected a high value of pulp/peel ratio earlier than the untreated ones. This may be attributed to the early ripening of the treated fruits. It is also noticeable that 2, 4-D-treated banana fruits reached a higher value of pulp/peel ratio than either the untreated ones or those treated with acetylene or coal gas.

TABLE III

Effect of some chemical treatments on the pulp/peel ratio during artificial ripening of banana fruits

Period of ripening (in days)	Treatments			
	Control	2, 4-D	Acetylene	Coal gas
0	1·03	1·09	1·09	1·09
3	1·09	1·15	1·14	1·15
6	1·13	1·24	1·20	1·35
9	1·14	1·45	1·45	1·68
12	1·18	1·61	1·69	1·95
15	1·26	2·82		
18	1·36	2·86		
21	1·42			
24	2·36			
27	2·35			
30	2·19			

4. *Total Soluble Solids Percentage.*—Data in Table IV show a progressive and consistent increase in the total soluble solids during the ripening of the banana fruits. This was true of both treated and untreated fruits. This increase was faster in the treated than in the untreated fruits. The untreated fruits and fruits treated with 2, 4-D, acetylene and coal gas yielded 18·4, 20·0, 18·0 and 18·4% of total soluble solids upon attaining the ripeness condition, respectively. The untreated fruits, as well as those treated with 2, 4-D, acetylene and coal gas reached the eating stage at 27, 9, 6 and 6 days respectively after the beginning of the ripening period.

The increase of total soluble solids of banana fruits during the ripening process is attributed to the increase of soluble constituents of the fruits, *i.e.*, sugars. These results are in agreement with those reported by Abd El-Wahab *et al.*[1] who found that the total soluble solids increased steadily during the artificial ripening of banana fruits treated with 2, 4-D and that the increase was earlier in the treated than in the untreated ones.

TABLE IV

Effect of some chemical treatments on the total soluble solids percentage during the artificial ripening of banana fruits

Period of ripening (in days)	Treatments			
	Control	2, 4-D	Acetylene	Coal gas
0	4·0	4·0	4·0	4·0
3	4·0	8·6	12·0	11·2
6	4·0	14·0	18·0	18·4
9	4·0	20·0	20·8	20·0
12	4·0	20·8	20·8	20·8
15	4·4	21·0		
18	6·4	21·6		
21	12·8			
24	16·0			
27	18·4			
30	21·4			

5. *Titrable Acidity.*—Titrable acidity is a function of the organic acids in the fruits. The amount of titrable acidity is a resultant of two main factors: the rate of organic acid assimilation and the rate of its oxidation to carbonic acid and water. Table V shows that the titrable acidity in the banana fruits of the control, 2, 4-D, acetylene and coal gas treatments reached its peak at 24, 9, 6 and 6 days, respectively, during the artificial ripening process. This peak coincided with the appearance of the first signs of ripeness. The rate of increase of titrable acidity at the beginning of the ripening period was faster in the treated than in the untreated fruits. There was a decline of titrable acidity in the fruits, after it has reached its maximum peak. This suggests that the biological activities, which favour the formation of acids, are responsible for the increase in titrable acidity. It is also noticeable that the 2, 4-D-treated fruits yielded the least value of titrable acidity, when attaining the eating conditions. This indicates that the 2, 4-D-treated fruits show a more palatable and sweet taste than those of the other treatments. Generally, the titrable acidity showed a progressive and consistent increase until the fruits reached the ripening conditions, followed by a reduction till the end of the ripening period.

6. *Respirational Activity.*—It is obvious from Fig. 1 that the untreated banana fruits showed a low initial value of respirational activity, followed by a period of levelling off. This was

TABLE V

Effect of some chemical treatments on the titrable acidity during the artificial ripening of banana fruits

Period of ripening (in days)	Treatments			
	Control	2, 4-D	Acetylene	Coal gas
0	0·212	0·212	0·212	0·212
3	0·264	0·337	0·443	0·450
6	0·241	0·386	0·468	0·456
9	0·289	0·422	0·323	0·318
12	0·358	0·408	0·288	0·309
15	0·259	0·255		
18	0·330	0·236		
21	0·434			
24	0·456			
27	0·368			
30	0·352			

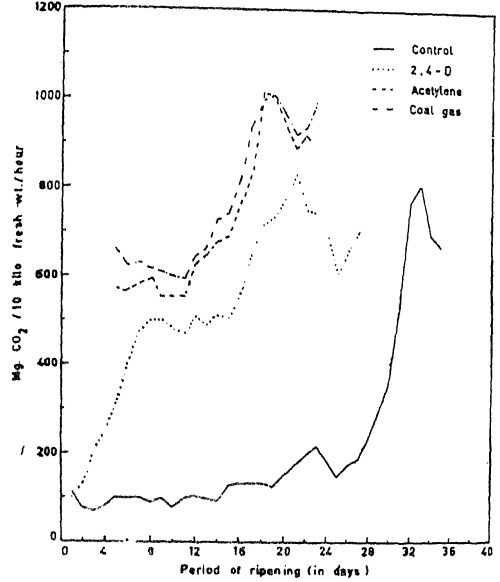


FIG. 1. Effect of some chemical treatments on the respirational activity during the artificial ripening of banana fruits.

followed by a striking increase which attained its peak when the fruits reached the over-ripe stage. On the other hand, the treated fruits reflected a relatively high initial value for respiration, followed by a rapid increase which coincided also with the over-ripe stage. The climacteric rise in treated fruits was attained with the ripeness condition. The 2, 4-D treatment accelerated the respirational activity of the banana fruits, and consequently enhanced the ripening condition. Fruits treated with acetylene and coal gas behaved similarly. The start of increase in the respirational activity coincided with the beginning of the ripening condition and reached its peak with the over-ripe stage. This was true in both the treated and untreated banana fruits. Fruits treated with 2, 4-D have a longer period of marketability than either the untreated fruits or those treated with coal gas and acetylene.

SUMMARY

Mature banana fruits were subjected to three different treatments, *i.e.*, 2, 4-D, acetylene and coal gas for the induction of artificial ripening. Although the color development was faster in fruits exposed to acetylene than those of the other treatments, 2, 4-D-treated fruits showed a longer marketing time. Peeling of fruits was enhanced with all treatments earlier in acetylene treatment. Compared with the untreated fruits, the treated ones reached the highest attainable pulp/peel ratio in a much shorter time. The total soluble solids of treated fruits increased at a much faster rate and reached the highest attainable values in a shorter time than in the untreated ones. No difference was found between different treatments in this respect. The rate of increase of titrable acidity was faster in treated than in the untreated fruits, and the peak was attained after 6, 6 and 9 days for treatments with acetylene, coal gas and 2, 4-D, respectively, as compared to 24 days for the untreated fruits. Treatments with 2, 4-D, acetylene and coal gas accelerated the respirational activity of the fruits and consequently enhanced the ripening process. Generally, it may be concluded that the application of 2, 4-D for the artificial ripening of banana fruits is much cheaper, and surpassed the other treatments with acetylene or coal gas in extending the marketing period of the fruits.

---

1. Abd-El-Wahab, F. K., "Effect of growth-regulating substances on maturity and ripening of banana fruits," *M.Sc. Thesis*, Fac. of Agric., Ain Shams Univ., U.A.R.
2. Abou Aziz, A. B., Wally, Y. A. and El-Nabauy, S. M., "Artificial ripening of banana fruits," *Res. Bull.*, Ain Shams Univ, Fac. of Agric., Cairo, 30 May 1969.
3. Burg, S. P., "The physiology of ethylene formation," *Ann. Rev. Plant. Physiol.*, 1962, **13**, 265.
4. Gane, R., "A study of the respiration of bananas," *New Phyto.*, 1936, **35**, 382.
5. Hansen, E., Effect of 2, 4-D on the ripening of Bartlett pears." *Plant Physiol.* 1946 **21**, 388.
6. Kidd, F. and West, C., "The influence of carbon dioxide, oxygen and the rate of ventilation upon the storage ripening and respiration of bananas," *Dept. Sci. Ind. Res. Food Invest. Board Rep.*, 1931, p. 103.
7. Marth, P. C. and Mitchell, J. W., "Studies of the effects of growth-regulating substances on the ripening rate of detached bananas," *Bot. Gaz.*, 1949, **110**, 514.
8. von Loesecke, W. H., *Bananas: Chemistry, Physiology and Technology*, Second Revised Edition, Interscience Publishers, Inc., New York and London, 1950, pp. 4, 6, 59, 87.
9. Wardlaw, C. W. and Leonard, E. R., "Studies in tropical fruits," *Ann. Bot. Lond.*, 1940, **3**, 27.

LETTERS TO THE EDITOR

ULTRASONIC RELAXATION IN PHENYL SALICYLATE

AMONG the various relaxing organic liquids which exhibit rotational isomerism, esters[1-3] of monocarboxylic acids are of special interest because of the fact that the relaxation frequency in these substances lies in the low megacycle region which is easily accessible to the conventional pulse technique.

With a view to confirm the relaxation in esters of salicylic acids the authors have studied the ultrasonic absorption and velocity using the standard pulse technique in the frequency range of 3–21 Mc/sec and the temperature range of 50–80° C. for phenyl salicylate. The ultrasonic cell is a double-walled glass cell and the desired temperature is maintained by circulating water through the jacket from a thermostat which is capable of maintaining the temperature of the circulating water within ± 0·1° C. The velocity measurements are accurate to ± 0·5% and the absorption measurements within ± 10%. The substance is a sample from B.D.H. and is distilled before use.

The ultrasonic velocity is found to decrease linearly with temperature as is normal in organic liquids. It is found that there is an abnormal variation of α/f^2 with frequency where 'α' is the absorption coefficient and 'f' is the frequency. Thus it is expected that the relaxation frequency lies within the frequency region of study.

If a single relaxation frequency (f_r) is assumed the frequency variation of the absorption parameter can be represented by the equation of the form

$$\frac{\alpha}{f^2} = \mathrm{B} + \frac{\mathrm{A}}{1 + (f/f_r)^2},$$

where B is the high frequency residual absorption which is determined by giving various values to B until a plot of $(\alpha/f^2 - \mathrm{B})^{-1}$ *versus* f^2 gives a straight line. From the intercept and the slope of this straight line, 'A' and the relaxation frequency 'f_r' have been computed. The excess absorption per wavelength μ has been computed using the relation $\mu = \alpha'\lambda = (\alpha/f^2 - \mathrm{B})\ fv$, where v is the velocity of sound.

In Fig. 1 excess absorption per wavelength $\alpha'\lambda$ *versus* frequency is plotted for different temperatures. It can be seen that the characteristic bell-shaped curves are obtained at all temperatures in the frequency region studied.

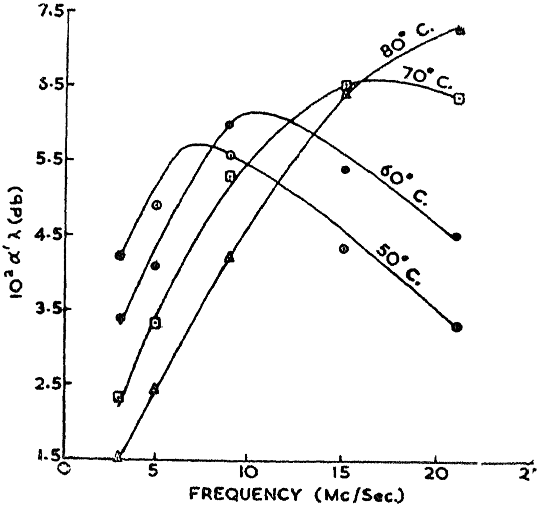


FIG. 1

The relaxation frequency is centred around 10 Mc/sec at 60° C. It can also be seen that the relaxation frequency which corresponds to the frequency of the peak excess absorption increases with increasing temperature. The variation of relaxation frequency is also studied with concentration in polar solvent acetone and non-polar solvent n-hexane and it is found that 'f' in both the solvents is independent of concentration within experimental error. As this is characteristic of rotational isomerism this relaxation has been attributed to rotational isomerism.

We are grateful to Prof. B. R. Rao for his encouragement and to the Council of Scientific and Industrial Research for the financial assistance.

Dept. of Physics, P. CHANDRASEKHARA RAJU.
Andhra University, K. SUBBA RAO.
Waltair, *September* 9, 1970.

---

1. Karpovich, J., *J. Chem. Phys.*, 1954, **22**, 1767.
2. —, *J. Acoust. Soc. Am.*, 1954, **26**, 819.
3. Murty, J. S. R. and Rao, B. R., Convention of the P.R.C. of the C.S.I.R., Nainital, 1970, 1–11.

THICKNESS DEPENDENCE OF ELASTIC WAVE VELOCITIES IN CERTAIN ARALDITES

In view of the growing importance of the epoxy resins in general, and the araldites in particular, in different spheres of industry, the authors have been interested in the study of the elastic properties of araldites. For this purpose, araldite castings with four compositions, 5 : 5, 5 : 4, 5 : 3 and 5 : 2 of the araldite AY 105 and the hardener HY 953 F supplied by CIBA (India) Ltd., have been studied at 29° C. by an ultrasonic rotating plate method. In all the cases, longitudinal and transverse wave velocities have been determined. The tank liquid chosen is carbon tetrachloride in view of its low ultrasonic velocity. The specimens chosen are in the shape of rectangular plates. All the specimens have been annealed to relieve residual stresses.

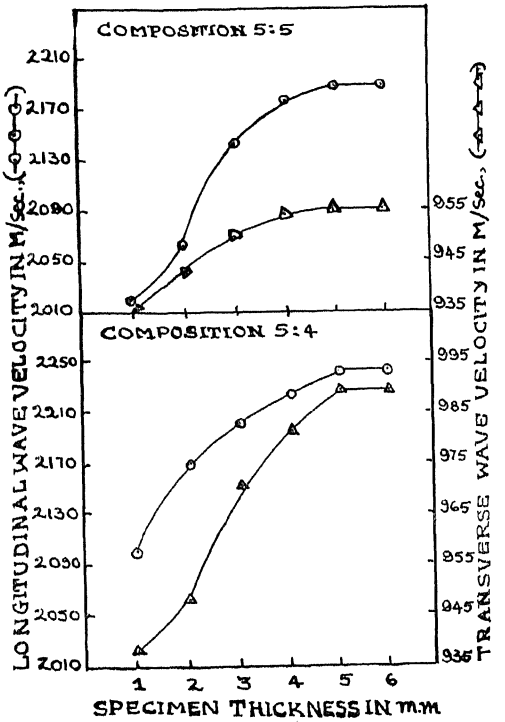


FIG. 1. Variation of elastic wave velocities with thickness of the specimen.

In a preliminary investigation, the authors have suspected a thickness dependence of the ultrasonic wave velocities in these specimens. In view of the existence of similar reports by Schneider and Burton,[1] Balakrishna and Krishnamurty,[2] and Subrahmanyam and Krishnamurty,[3] in the case of certain polycrystalline metals, the authors have made detailed measurements of velocities in about six plates of different thickness in each composition. Figures 1 and 2 are graphical illustrations of the data obtained.

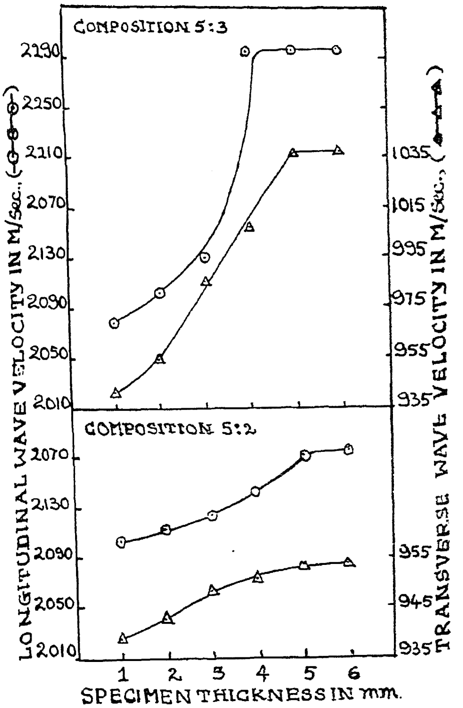


FIG. 2. Variation of elastic wave velocities with thickness of the specimen.

There is clear evidence, as the curves manifest, that as the thickness increases, the velocity also increases and becomes constant at about a thickness of 5 mm. in the several cases studied. Since the frequency of the ultrasonic wave employed in the investigation is 500 kc./sec., the wavelength of the ultrasonic wave works out to be about 4·6 mm. For this calculation of the wavelength, the velocity value of 2296 m./sec., which is the maximum constant value obtained in the present measurements, is chosen.

It looks as though it is a common feature with all polycrystalline substances that the ultrasonic velocities, and hence the related moduli, depend on the thickness of the specimen when it is chosen in the shape of a plate. This result should be taken care of in an attempt to determine the elastic properties of the polycrystalline substances.

The authors are highly grateful to Prof. Bh. Krishnamurty and Dr. T. V. Kameswara Rao, Andhra University, Waltair, for their interest in the work.

Dept. of Engineering P. VENKATESWARA RAO.*
Physics, T. VISWESWAR.
Andhra University,
Waltair, *September* 29, 1970.

---

* Department of Applied Physics, Andhra University, Waltair.

1. William, C. Schneider and Charles, J. Burton, *Jour. App. Phys.*, 1949, **20**, 48.
2. Balakrishna, S. and Krishnamurty, M., *Proc. Ind. Acad. Sci.*, 1953, **38 A**, **495**.
3. Subrahmanyam, B. and Krishnamurty, Bh., *Indian Journal of Pure and Applied Physics*, 1963, **1** (3), 97.

THE EFFECT OF TEMPERATURE AND PRESSURE ON CHEMISORPTION KINETICS

AN examination of the adsorption kinetic data in literature[1,2] shows that the Elovich plots show either a linear variation of q as a function of log $(t + t_0)$ (Fig. 1, curve 1) or a deceleration rate following the initial rate (Fig. 1, curve 2) or the initial rate followed by an acceleration which in turn is followed by a deceleration (Fig. 1, curve 3). We propose the following explanation to rationalise the types of Elovich plots generally realised under experimental conditions and have presented results obtained by us on the chemisorption of hydrogen on iron oxide (Fe_2O_3) in support of the explanation. The analysis of the data in literature[3,4] shows that the linear variation of q with log t is obtained for adsorption under the following conditions:

(*a*) low pressure-low temperature, and
(*b*) high pressure-high temperature

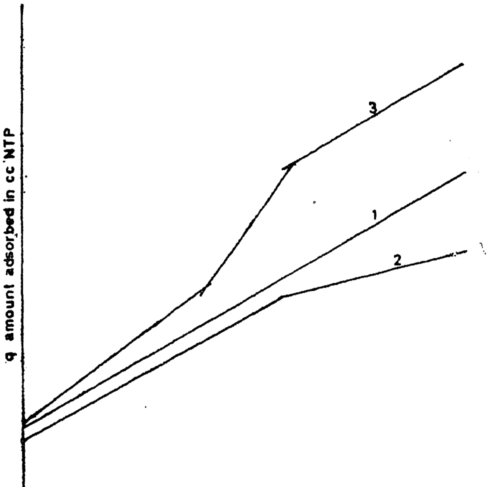


FIG. 1. Typical Elovich plots.

In the former case, the authors feel that the low pressure restricts the availability of gas molecules, while the low temperature brings into operation only the set of highly active surface sites. In the latter case, the high temperature assists the activation of less active sites, thus bringing in more sites to compete for the increased gas phase composition. Both these conditions would therefore result in a linear variation of amount adsorbed with respect to log $(t + t_0)$.

The kinetic plot with a deceleratory range might be obtained either due to a deficiency in gas phase concentration or due to the deficiency of sites as adsorption proceeds. Thus, plots of type 2 might be expected to be realised under high temperature-low pressure or low temperature-high pressure conditions. In the former case, while the high temperature ensures the existence of a large number of activated sites, the low pressure restricts the availability of gas molecules for adsorption. In the latter case, the available sites would be much less compared to the gas phase concentration.

The presence of an acceleratory region in the type 3 plot shows an increased "site density" after adsorption over an initial period. The increase in the number of sites might be accounted for on the basis that the initially adsorbed species activate adjacent sites[5,6] thus effectively increasing local concentration of sites and hence resulting in increased adsorption. The final deceleration would be obviously due to an overall decrease in the number of sites.

The results of the investigation of the kinetics of chemisorption of hydrogen carried out by the conventional volumetric technique[6] on iron oxide (Fe_2O_3), prepared by the decomposition of AnalaR grade ferric nitrate in the temperature range 0–160° C., in this laboratory, have been analysed through the Elovich equation and the Elovich plots are presented in Figs. 2 and 3. These results could be analysed through the general classification referred to earlier. It can be seen from Fig. 2 that at the highest temperature studied, namely, 160° C., a linear plot is obtained while the Elovich plots at lower temperatures and at atmospheric pressure show either a deceleration step or an acceleration step followed by deceleration in the temperature range 26-142° C. It will be seen from Fig. 2 that in the temperature range 80–142° C., there is only a deceleratory region following the initial linear kinetics. In this instance, it may be interpreted that an increase in temperature activates a majority of sites and the gas concentration being constant this results in an extended linear kinetics. However, with progress of adsorption, there would be deceleration on account of an overall deficiency of sites.

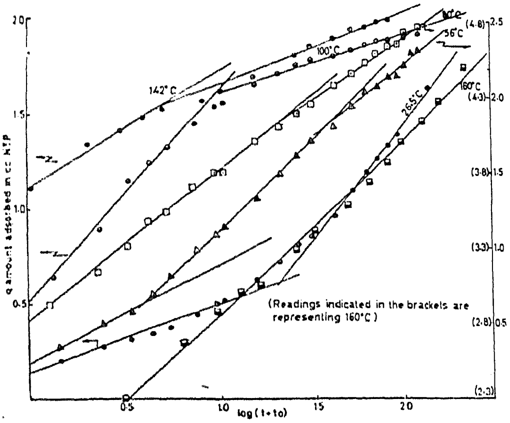


FIG. 2. Elovich plots for the chemisorption of hydrogen on iron oxide—effect of temperature.

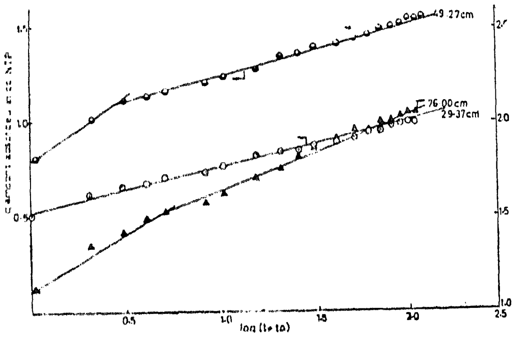


FIG. 3. Elovich plots for the chemisorption of hydrogen on iron oxide—effect of pressure.

Figure 3 shows the effect of pressure on the Elovich kinetics at 142° C. It is seen that the deceleration step sets in with increase of pressure obviously due to a deficiency of adsorption sites for the increased gas concentration. The effect of pressure and temperature on the nature of isothermal anomalies in the Elovich plots in the light of the above discussion needs further extensive studies, which are currently in progress in this laboratory.

Dept. of Chemistry,
Indian Inst. of Technology,
Madras-36, India,
August 26, 1970.

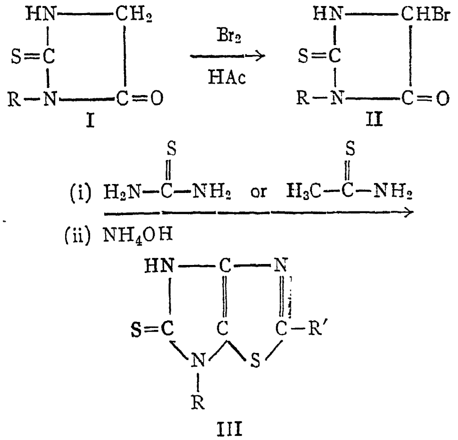
R. P. VISWANATH.
B. VISWANATHAN.
V. SRINIVASAN.
M. V. C. SASTRI.

1. Low, M. J, D., *Can. J. Chem.*, 1960, **38**, 588.
2. —, *Chem. Revs.*, 1960, **63**, 281.
3. —, *J. Am. Chem. Soc.*, 1965, **87**, 7.
4. Viswanathan, N. S. and Yeddanapalli, L. M., *Can. J. Chem.*, 1969, **47**, 2933.
5. Allen, J. A. and Scaife, P. H., *Aust. J. Chem.*, 1966, **19**, 2015; 1967, **20**, 399.
6. Chandrasekaran, N., Viswanathan, B., Srinivasan, V. and Sastri, M. V. C., *Ibid.*, 1968, **21**, 2575.

SYNTHESIS OF THIAZOLOTHIOHYDANTOIN DERIVATIVES

IN a study of the synthesis and biological activity of thiazole and thiohydantoin derivatives we have synthesised some thiazolothiohydantoin derivatives by condensation of bromo derivatives of substituted thiohydantoins with thiourea and thioacetamide.

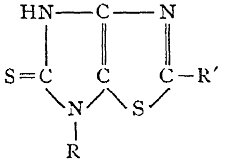
Experimental.—The substituted thiohydantoins (I) were prepared by the reaction of glycine with aryl isothiocyanates.[1] Since introduction of halogens increases fungicidal properties,[2,3] the substituted thiohydantoins were brominated with bromine (1 : 1 Mole) in acetic acid to give the monobromo derivatives (II). The bromine was attached to the active methylene[1,4] group in 4-position of the thiohydantoin derivatives. The hydrobromides of thiazolothiohydantoin derivatives were obtained by refluxing the bromo compounds (1 Mole) with either thiourea or thioacetamide (1·5 Mole) in absolute alcohol. The thiazolothiohydantoin derivatives were obtained after basification with dilute ammonium hydroxide as coloured compounds (III). The melting points,



a—R′=NH$_2$ *b*—R′=CH$_3$

yields, and analytical data of the thiazolothiohydantoin derivatives are given in Table I.

TABLE I



No.	Nature of R	Nature of R′	Yield %	M.P. °C.	Percentage of sulphur	
					Found	Cal.
1	Phenyl ..	$-NH_2$	55	>250	25·52	25·80
2	*o*-Tolyl ..	,,	55	173	24·05	44·13
3	*p*-Tolyl ..	,,	60	178–182	24·15	24·43
4	*p*-Chlorophenyl	,,	65	170–172	22·34	22·66
5	*o*-Methoxyphenyl	,,	70	>250	22·80	23·02
6	*p*-Methoxyphenyl	,,	65	157	22·71	23·02
7	*p*-Ethoxyphenyl	,,	70	>250	22·41	21·92
8	*p*-Tolyl ..	$-CH_3$	60	174	24·98	24·52
9	*p*-Chlorophenyl	,,	50	180	23·26	22·74

Dept. of Chemistry, B. DASH.
Utkal University, S. K. MAHAPATRA.
Vani Vihar, Bhubaneswar-4,
September 14, 1970.

---

1. Pujari, H. K. and Rout, M. K., *J. Ind. Chem. Soc.*, 1954, **31**, 937.
2. Goldsworthy and Green, *Phytopath.*, 1939, **29**, 700.
3. Mahapatra, G. N., *Nature*, 1956, **177**, 938; *J. Am. Chem. Soc.*, 1957, **79**, 938.
4. Dash, B., Patnaik, B. K. and Rout, M. K., *J. Ind. Chem. Soc.*, 1960, **37**, 603.

CRYSTAL STRUCTURE OF DICHLOROMALONAMIDE

THE crystal and molecular structure of malonamide, $CH_2(CONH_2)_2$, has been determined[1] and correlated with the findings of e.s.r. studies on γ-irradiated samples.[2,3] To assist in interpretation of e.s.r. data[4] for γ-irradiated dichloromalonamide, $CCl_2(CONH_2)_2$, a structure determination has been undertaken.

Crystals of dichloromalonamide from ethanol are colourless prisms elongated along *c* with prominent {110} faces. Unit cell and space group data were obtained from rotation, Weissenberg and precession films and on a spectrogoniometer. The crystals are monoclinic, $a = 10{\cdot}514$, $b = 5{\cdot}985$, $c = 10{\cdot}371$ Å, $\beta = 101{\cdot}44°$, Space group I 2/a (C_{2h}^6), $D_m = 1{\cdot}76$ cm.$^{-3}$, $Z = 4$, and $D_x = 1{\cdot}77$ g. cm.$^{-3}$

The intensities of 720 reflections were measured on a Datex-automated General Electric XRD6 on Spectrogoniometer with a scintillation counter and Mo-Kα radiation. The structure was determined by three-dimensional Patterson, Fourier, and difference Fourier syntheses, the positions of the hydrogen atoms being obtained from the difference Fourier map. Three cycles of least-squares refinement of positional parameters, anisotropic thermal parameters for chlorine, oxygen, nitrogen and carbon atoms, and isotropic thermal parameters for hydrogen atoms gave a final *R* of 0·031. The molecule is situated on a crystallographic two-fold axis; the final positional and thermal parameters are given in Table I and the configuration of the molecule is shown in Fig. 1.

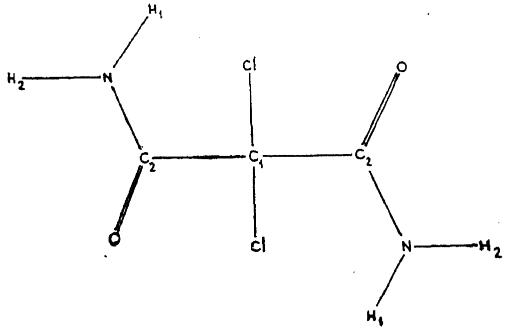


FIG. 1. Molecule of dichloromalonamide.

Details of the structure analysis, molecular packing and hydrogen-bonding in the crystal will be published elsewhere.

TABLE I

Positional and thermal parameters

	x	y	z	β_{11}	β_{22}	β_{33}	β_{12}	β_{13}	β_{23}
Cl ..	0·0198	0·1664	0·3909	0·0103	0·0217	0·0084	0·0010	0·0031	0·00
C (1) ..	0·00	0·3385	0·2500	0·0063	0·0151	0·0049	0·00	0·0022	0·00
C (2) ..	0·1196	0·4948	0·2548	0·0050	0·0196	0·0051	0·0002	0·0018	0·0004
O ..	0·1572	0·5352	0·1534	0·0093	0·0371	0·0056	−0·0070	0·0036	−0·0015
N ..	0·1671	0·5866	0·3700	0·0076	0·0300	0·0055	−0·0049	0·0023	−0·0014
H (1) ..	0·1360	0·5581	0·4434	4·0(*B*)	..	..	..	..	..
H (2) ..	0 2266	0·6963	0·3706	4·1(*B*)	..	..	..	..	..

The authors wish to thank Dr. D. Chadwick for the crystals and one of us (K. V. K.) expresses his thanks to the Royal Society and Nuffield Foundation, London, for the grant of a Research Bursary.

Dept. of Chemistry, University of British Columbia, Vancouver-8, Canada, *September* 26, 1970.

J. A. Lerbscher.
K. V. Krishna Rao.*
J. Trotter.

---

* On leave from Physics Department, Osmania University, Hyderabad-7, India.

1. Chieh, P. C., Subramaniam, E. and Trotter, J., *J. Chem. Soc.* (*A*), 1970, p. 179.
2. Rexroad, H. N., Hahn, Y. H and Temple, W. J., *J. Chem. Phys.*, 1965, **42**, **324**.
3. Cyr, N. and Lin, W. C., *Chem. Comm.*, 1967, p. 192.
4. Chadwick, D., Private Communication.

CORUNDOPHILITE FROM A PELITIC SCHIST NEAR SYDAPURAM, NELLORE DISTRICT, ANDHRA PRADESH

Corundophilite, a rare Mg-Al. chlorite, is found to occur in association with margarite, staurolite, corundum, magnetite and hematite in a pelitic schist from Devaratippa (57 N/12; 14° 11′ 24″ : 79° 44′ 30″) about 400 metres north-west of Sydapuram of Nellore District, Andhra Pradesh. The occurrence of margarite has already been reported by one of the authors.[1] The present note gives an account of the mineralogical and chemical investgations carried out on corundophilite and its paragenesis.

The pelitic schist is a dark reddish-brown, hard and compact rock with a poorly developed schistosity. In certain portions of the rock, metallic flakes of specular with splendent lustre are present. The colour of the rock is due to the presence of red ochreous hematite along the grain boundaries and cracks. Under the microscope, the rock exhibits decussate, porphyroblastic and blastoporphyritic textures. Corundophilite and margarite are lath-shaped, arranged in a decussate fashion, and occur mainly as aggregates enclosed in rectangular to irregular areas, the cores of which are often staurolite. Some laths of margarite also assume porphyroblastic dimensions. The laths of corundophilite and margarite are sometimes seen to shoot into staurolitic cores. Some of the magnetite is seen to alter into specular and hematite. Corundum occurs as discrete anhedral grains of small size.

Corundophilite is pleochroic from green ($\alpha = \beta$) to pale greenish-yellow (γ) and is biaxial positive with 2 V ranging from 0° to 15°. The refractive indices of the mineral, as determined by the standard immersion method, are $\alpha = \beta = 1{\cdot}613$ and $\gamma = 1{\cdot}617$. The specific gravity of the mineral, as determined by the pycnometer method, is 2·87. The ω value calculated in accordance with the formula of Hey[2] is 1·616. A pure crop of chlorite is obtained for mineral analysis by repeatedly washing the crushed grains of the rock in hot 10% oxalic acid solution to remove the red stain of hematite and then subjecting the rock powder to repeated magnetic separation by using a hand magnet and a Frantz isodynamic separator. The mineral powder, dried at 105° C., is analysed by an adaptation of the method of Shapiro and Brannock[3] and the chemical analysis is presented in Table I.

Table I

SiO_2	..	23·75
Al_2O_3	..	26·71
Fe_2O_3	..	3·40
FeO	..	14·10
MnO	..	0·02
MgO	..	20·43
H_2O^+	..	11·54
Total	..	99·95

Analyst: C. V. Seshadri.

The structural formula of the mineral can be given as:

$$[Mg_{6\cdot112}, Al_{3\cdot087}, Fe^{+2}_{2\cdot369}\ Fe^{+3}_{0\cdot514}, Mn_{0\cdot004}]_{12\cdot0}\ [Si_{4\cdot767}, Al_{3,233}]_8\ O_{20}\ (OH)_{15\cdot45}.$$

The chemical data suggest that the mineral has been oxidised, a little of Fe^{+2} $(OH)^{-1}$ being substituted by Fe^{+3} O^{-2}.

The only other locality known to the authors where corundophilite and margarite occur together is from the emery deposits of Chester County, Massachusetts, where Shannon and Wherry[4] gave a metasomatic origin for the mineral. In the present case, it is believed that the two minerals were formed in a silica-deficient system at the expense of staurolite by lime and magnesia metasomatism in accordance with the following equation:

$$\underset{\text{Stavrolite}}{6FeAl_4Si_2O_{10}\ (OH)_2} + 12MgO + 3CaO + 9H_2O + 2O \rightarrow \underset{\text{Corundophilite}}{3Mg_4\,Al_4Si_2O_{10}\,(OH)_8} + \underset{\text{Margarite}}{3Ca\,Al_4Si_2O_{10}\,(OH)_2} + \underset{\text{Magnetite}}{2Fe\,Fe_2O_4}$$

From the occurrence of the pelitic schists in an area occupied predominantly by schistose amphibolites of almandine-amphibolite facies[5] and from the restricted distribution of these minerals, it may be concluded that chlorite and margarite were formed as a consequence of retrogressive metamorphism. From the statement of Ramberg[6] that aluminous chlorite (corundophilite) forms along with biotite during progressive metamorphism of pelitic sediments, it may be stated that the P.T. conditions of the formation of corundophilite corresponds to that of biotite zone.

The authors are grateful to Prof. M. G. Chakrapani Naidu for providing facilities and for encouragement. One of the authors (C. V. S.) expresses his gratitude to the CSIR, New Delhi, for financial assistance.

Dept. of Geology,
Sri Venkateswara University,
Tirupati, *August* 26, 1970.

C. V. Seshadri.
R. Jagadiswara Rao.

---

1. Jagadiswara Rao, R., *Indian Mineralogist*, 1962, **3**, 67.
2. Hey, H. H., *Min. Mag.*, 1954, **30**, 277.
3. Shapiro, L. and Brannock, W. W., *U.S. Geol. Surv. Bull.*, 1962, p. 1144-A.
4. Shannon, E. V. and Wherry, E. T., *Jour. Wash. Acad. Sci.*, 1922, **12**, 239.
5. Jagadiswara Rao, R., Unpublished Ph.D. Thesis, Sri Venkateswara University, Tirupati, 1965.
6. Ramberg, H., *The Origin of Metamorphic and Metasomatic Rocks*, Chicago University Press, 1952.

SEASONAL OCCURRENCE OF *ELONGOPARORCHIS PNEUMATIS* HANUMANTHA RAO, 1961, IN THE AIR-BLADDER OF THE CAT-FISH *ARIUS THALASSINUS* RUPPELL FROM BAY OF BENGAL

Investigations on ecology of parasites have been chiefly restricted to temperate regions. In a tropical country like India, factors influencing the distribution of parasites may be expected to be significantly different. The results of a preliminary investigation on the seasonal abundance of the isoparorchiid trematode, *Elongoparorchis pneumatis* Hanumantha Rao, 1961, from the air-bladder of the cat-fish, *Arius thalassinus* Ruppell, are presented here. *A. thalassinus* which is common throughout the year is now a new host added for *E. pneumatis*. A total of 78 fish were examined during the period January to December 1969. The fish were collected after the trawling operations of the offshore fishing station at Waltair.

E. pneumatis inhabits the anterior chamber of air-bladder and lives attached to the rete mirabele feeding on the blood drawn from the capillaries. The presence of the more or less sluggish worms could be easily recognized by the black haematin deposited by them on the opaque white walls of the air-bladder. Of the 78 fishes examined, 30 were found to be infected, the percentage of infection being nearly 38·5. There is no seasonal variation in the incidence of infection. The worms are found throughout the year except during the months of May and July. However, a clear-cut seasonal variation in the occurrence of different growth stages of the parasite is apparent. For convenience, the various growth stages of *E. pneumatis* have been divided into four groups. Group 1 comprises small immature worms of glassy transparency having conspicuous haematin loaded serpentine caeca. Group 2 comprises worms which are mature in the sense that the reproductive organs are fully formed and egg formation has already started. In Group 3 are included gravid worms where the uterus is gorged with eggs. The senile worms in which the uterus is empty and the reproductive organs have exhausted are included under Group 4. Table I shows the seasonal distribution of these four groups during the period of investigation. Immature worms started appearing in large numbers in August and they continued till December. Mature worms are found during November to February being abundant during November. Gravid worms are found scattered and during February to April, the air-bladder contained senile flukes occasionally. It becomes obvious that the cat-fish gets infected during August to December

Table I

Seasonal occurrence of various growth stages of E. pneumatis *in the air-bladder of* A. thalassinus *during January to December 1969*

Month	No. of fish examined	No. of fish infected	No. of parasites obtained				
			Groups				Total
			1	2	3	4	
January ..	5	3	0	3	0	0	3
February ..	6	3	0	4	0	1	5
March ..	2	1	0	0	1	0	1
April ..	4	1	0	0	0	1	1
May ..	6	0	0	0	0	0	0
June ..	6	1	0	0	0	1	1
July ..	4	0	0	0	0	0	0
August ..	10	4	19	0	0	1	20
September	8	3	2	2	1	0	5
October ..	5	2	1	0	2	0	3
November	18	11	0	19	1	0	20
December ..	4	1	5	1	0	0	6

and the flukes that have established during this period become mature from September to February, the first egg appearing in September. They are full of eggs from December to April, later the fish do not show any infection being characteristically free of parasites from May to July. It would appear that this period is spent by the parasite in the intermediate host. These facts allow us to suggest the operation of an annual cycle for *E. pneumatis*. Such annual cycles have been previously reported for several digenetic trematodes like *Bunodera luciopercae*, *Asymphylodora tincae*, *Coitocaecum skrjabini*, *Allocreadium isoporum* and *Sphaerostoma bramae*.[1]

No metacercariae of *E. pneumatis* could be encountered in the gut of cat-fish. During the period when the air-bladder contained immature flukes, small crabs and other decapod crustaceans were the predominant items of diet as judged by the stomach contents. Probably one of these acts as the second intermediate host.

The degree of infection is shown in Table II. The fish have never been heavily parasitized.

TABLE II

Degree of infection of A. thalassinus *with* E. pneumatis

No. of parasites	1	2	3	4	5	6	7	8
Frequency ..	13	11	2	1	0	2	0	1

Altogether 65 flukes could be collected out of the 30 infected hosts. Most commonly 1 or 2 parasites per host could be collected. The largest number recovered from a single host was 8. In general immature flukes occurred in larger numbers per host than the other stages. Some mortality of immature stages before reaching maturity seems evident.

The hosts examined for parasites ranged in size from 14 cm. to 25 cm. There was no significant difference in the incidence of infection in fish of different lengths. In addition to *E. pneumatis* certain other parasites were frequently harboured by cat-fishes. *Monodhelmis* sp. in the intestine and *Aponurus* sp. in the stomach were present in small numbers. Monogenetic trematodes on gills and plerocercoid stages in the intestine were commonly encountered. But these parasites do not appear to interfere with the occurrence of *E. pneumatis* in the air-bladder.

In conclusion it may be said that there are few studies dealing with seasonal abundance of trematodes in fish although some information is available on the parasite burden over a period of time.[2,3] The few investigations that have been conducted so far pertain to monogenetic trematodes and cestodes.[4-6] In view of the paucity of information on seasonal abundance of digenetic trematodes in fish more work is desirable.

Dept. of Zoology, K. HANUMANTHA RAO.
Andhra University,
Waltair,

and

Dept. of Biology, M. V. RAMANA RAO.
Andhra Medical College,
Visakhapatnam, *August* 29, 1970.

---

1. Dogiel, V. A., Petrushevski, G. K. and Polyanski, Y. I., *Parasitology of Fishes*, Oliver and Boyd, Edinburgh, London, 1961.
2. Lees, E., *Parasitology*, 1962, **52**, 95.
3. Threlfall, W., *Ibid.*, 1967, **57**, 431.
4. Chubb, J. C., *Ibid.*, 1963, **53**, 419.
5. Paling, J. E., *Ibid.*, 1965, **55**, 667.
6. Kennedy, C. R., *J. Parasit.*, 1968, **54**, 583.

ON *LACCOPORUS NIGRITULUS* (GSCHWENDTNER) COMB. NOV. (COLEOPTERA : DYTISCIDAE)

GSCHWENDTNER (1936) described *Laccophilus apicornis* var. *nigritulus* from Tibet: Tering, Gompa. The nominotypical form was described by Reiter (1899) from Mongolia: Changai-Gebirge.

The Holotype and Paratypes of *L. apicornis* var. *nigritulus* Gschwendtner are in the Zoological Survey of India, Calcutta, and a re-examination of these specimens reveals that they belong to the genus *Laccoporus* Balfour-Browne, 1939. The metatibial spurs are acutely pointed; the prosternal process is elongate and slightly carinated longitudinally; the reticulation on the elytra is irregular and the puncturation of the femora and the tibiae of the anterior and middle legs and the hind tibiae is very dense. In the absence of specimens of *Laccophilus apicornis* Reitter it is only conjectured that it may also belong to the genus *Laccoporus*. It may be possible to decide its exact relationship with *nigritulus* after a comparison of the genitalic characters but for the present it is considered here as a distinct species. These two species are also geographically isolated, though within the same palaearctic zone. The dorsal view of penis in *nigritulus* is shown in Fig. 1. It is bent just above the base and then twisted on itself, the apical portion is scooped in the form of a spoon.

Balfour-Browne (*l.c.*) described *Laccoporus viator* gen. et sp. nov. also from Tibet: Gyangtse. The specimens of *nigritulus* before me come very close to this species differing only in the smaller size, *viz.*, 4·3-4·6 mm. as against 4·79–5·18 mm. Both the species agree in having black ventral surface and in the abdominal sternites being rufo-flavis along the posterior border. Without physical examination of the specimens of *L. viator*, it cannot be said that the two species are conspecific but there is a strong likelihood of that being the case.

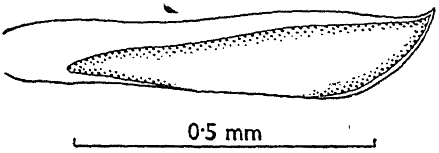


FIG. 1. Dorsal view of penis in *Laccoporus nigritulus* (Gschwendtner).

Among the many genera of the subfamily Laccophilinae, only *Laccophilus* and *Neptosternus* are known from India. The genus *Laccoporus* for the present comprises only the above species and is confined to Mongolia and Tibet.

Zoological Survey of India, T. G. VAZIRANI.
34, Chittaranjan Avenue,
Calcutta-12, *August* 31, 1970.

---

1. Balfour-Browne, J., "A contribution to the study of Dytiscidae—Coleoptera, Adephaga," *Ann. Mag. nat. Hist., London*, 1939, **3** (11), 97.
2. Gschwendtner, L., "Interresante und neue Schwimkafer des Indischen Museums in Calcutta," *Rec. Indian Mus.*, 1936, **37** (1935), 365.
3. Reitter, E., "Beitrage zur Coleopteren-Fauna des russischen Reiches und der angrenzenden Länder," *Deutch. Ent. Zeit.*, 1899, Pt. 1, p. 193.

PRESENCE OF CAECAL OUTGROWTHS IN THE ALIMENTARY CANAL OF A CENTIPEDE *ETHMOSTIGMUS SPINOSUS* NEWPORT (CHILOPODA: MYRIAPODA)

EVER since Plateau[1] gave an account of the alimentary canal of a centipede *Cryptops* sp., several workers have studied the morphology of the alimentary canal of a number of species of centipedes.[2-5] All these workers describe the alimentary canal of these myriapods as a straight tube without caecal outgrowths unlike in insects. Therefore it is quite interesting that we have observed the presence of caecal outgrowths in the alimentary canal of a common Indian centipede *Ethmostigmus spinosus*.

23 centipedes of this species of varying sizes and both the sexes were collected in the vicinity of Madras city and all of them were dissected for the examination of the alimentary canal; all the centipedes showed the presence of the caeca suggesting that these structures are regular organs of the alimentary canal of the species under study. The details of the caeca are given below.

The caecæ are in the form of short blind outgrowths, two on each side of the oesophagus (Fig. 1), lying in the segment bearing the 4th pair of legs. Both the caeca, on each side, are in the same line, one above the other. They are completely swathed by the large salivary glands which extend from the first to the sixth segment. Therefore the salivary glands have to be removed to expose the caeca.

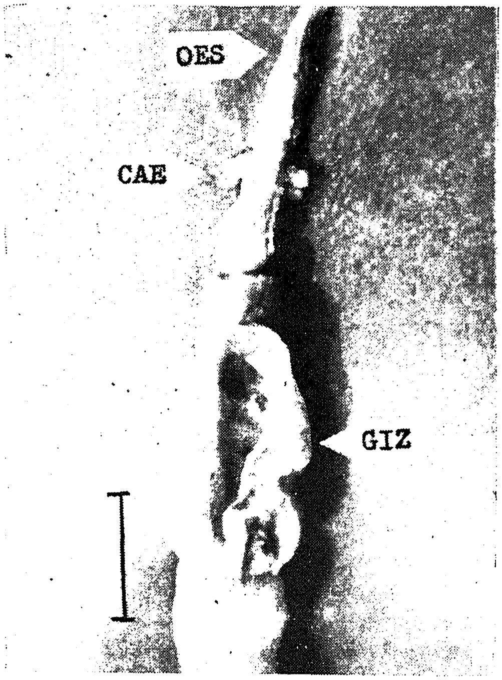


FIG. 1. Anterior region of the foregut of *Ethmostigmus spinosus* (Sallivary glands are removed). CAE, Caeca; GIZ, Gizzard; OES, Oesophagus (Scale line: Half a centimeter).

In order to study the histology of the caeca paraffin sections were prepared and examined after staining in Heidenhain's hæmatoxylin. Examinations of longitudinal sections of the caeca disclosed that they are hollow structures having a narrow lumen (Fig. 2) which opens into the cavity of the oesophagus. The walls of the caeca are made of different types of cells and based on the types of cells, three zones are distinguishable: a short distal zone of small cells, a middle zone of tall columnar cells without vacuoles and a long proximal zone of large cells containing vacuoles and granular inclusions in the cytoplasm (Fig. 2).

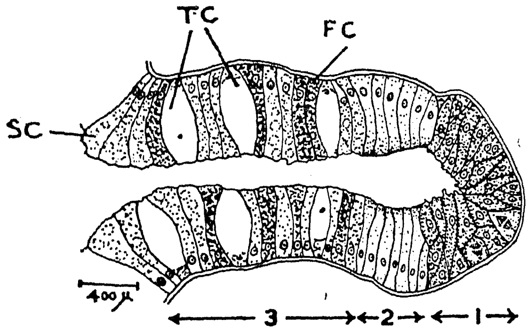


FIG. 2. L.S. through a caecum of *Ethmostigmus spinosus*, stained in Heidenhain's haematoxylin. 1, 2 & 3 are the distal, middle and proximal zones of the caecum, respectively. FC, First type of cells of the proximal zone; SC, Second type of cells of the proximal zone; TC, third type of cells of the proximal zone.

The cells of the distal zone are of varying sizes from 48 to 82 μ in height and 15 to 20 μ in width, with large ovoid nucleus, which is central in position and contains a single large nucleolus. The cytoplasm is densely granular without vacuoles. Several mitotic figures occur in this zone, indicating that the cells are in a state of proliferation.

The cells of the middle zone measure 295 to 534 μ in height and 60 to 62 μ in width. The nuclei are small and basal in position. The cytoplasm is clear without vacuoles and granular inclusions.

The cells in the proximal zone consist of what appears on cytological grounds to be three kinds of cells interspersed (Fig. 2). The first type of cells are 300 to 350 μ tall and 65 to 75 μ wide; they have small rounded vacuoles containing large granular inclusions, which stain intensely blue-black with Heidenhain's haematoxylin. The nucleus is basal in position. The second type of cells are similar to the former but the granular inclusions in the vacuoles are absent. The third type of cells are the largest, measuring 400 to 425 μ in height and 215 to 255 μ in width. Almost the entire cell is taken up by a large vacuole containing a non-granular material staining grey with Heidenhain's haematoxylin. The nuclei are very small and they are extreme basal in position.

The features of the caecae of *Ethmostigmus spinosus* recall those of the midgut caecae of beetles like *Dytiscus* sp.,[6] which are said to secrete digestive enzymes. In order to find out if, in the present instance also, the caecae are secretory in function, tests were performed for the presence of alkaline phosphatase.[7] Moog[8] and Danielli[9] state that alkaline phosphatase is frequently found in relationship with the secretory cells of animals. The cells of types 1 and 3 of the proximal zone of the caeca showed intensely positive reaction, while all the cells in the middle zone are faintly positive to the tests. These results may suggest that the cells in the distal and middle zones are secretory in function. The nature of the secretion and its role deserve further study.

I am grateful to Professor G Krishnan, Director, for his interest in this study. Thanks are due to the Research Scholars in our department for help in the collection and examination of the centipedes.

Dept. of Zoology, G. SUNDARA RAJULU.
Madras University,
Madras-5, *August* 17, 1970.

---

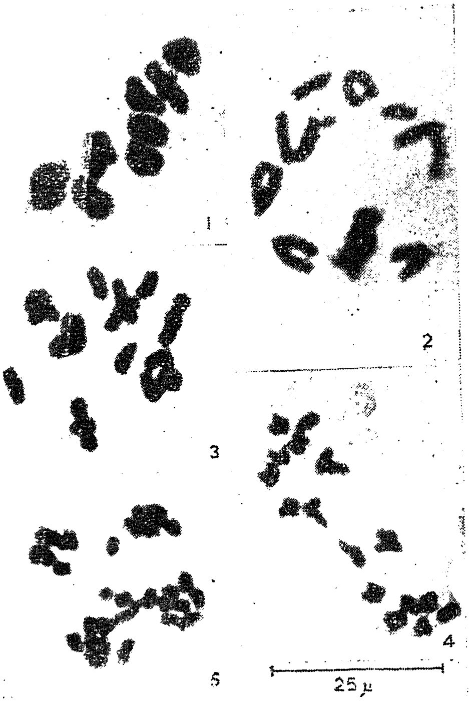
1. Plateau, F., *C.R. Soc. ent. Belg.*, 1887, **31**, 70.
2. Willem, V., *Ann. Soc. R. Malac. Belg.*, 1892, **27**, 69.
3. Lewis, J. G. E., *J. Mar. Biol. Assn., U.K.*, 1962, **42**, 655.
4. Shukla, G. S., *Ent. Berich.*, 1964, **24**, 55.
5. Seifert, G., *Z. Morph. Okol Tierre*, 1967, **58**, **347**.
6. Duspiva, F., *Protoplasma*, 1939, **32**, 211.
7. Gomori, G., *Microscopic Histochemistry*, University of Chicago Press, 1952.
8. Moog, F., *Biol. Rev.*, 1946, **21**, 41.
9. Danielli, J. F., *Proc. Roy. Soc. (B)*, 1964, **142**, 146.

MALE MEIOSIS IN *ARTEMISIA PALLENS* WALL.

Artemisia pallens Wall. (Compositae), a short-term annual, yields the highly valued 'Davana Oil' from its leaves, flowers and seeds and is cultivated for this purpose in Mysore, round about Poona in Maharashtra, Kerala, Madras and Andhra States. The oil is used in perfumery trade both in India and abroad. The species is gaining in its industrial importance but a serious handicap is its poor seed setting which is the only means of its reproduction. Although karyotypic analysis[1] has shown it to be a diploid ($2n = 16$) based on $x = 8$, a meiotic analysis may throw some light on the nature, extent and causes of seed sterility. Accordingly, young capitula were fixed in acetic alcohol

(1 : 3) at CIMPO (Bangalore) farm which were squashed in iron-acetocarmine.

Out of the 138 pollen mother cells scored at diakinesis and metaphase I, nearly 88·4% contained 8 II (Fig. 1), followed by 7·26% with 7 II + 2 I (Fig. 2) and 4·34% with 6 II + 4 I (Fig. 3). The bivalents possess 1–3 chiasmata and frequency per cell ranges from 14 to 16, with mean at 15. Terminalization coefficient at metaphase I is 0·53. Two bivalents are attached to the nucleolus at diakinesis which is in line with the presence of 4 nucleolar chromosomes in the karyotype.[1]



FIGS. 1–5. Fig. 1. Metaphase I, 8 II. Fig. 2. Diakinesis. 7 II and 2 I. Fig. 3. Metaphase I, 6 II and 4 I. Fig. 4. Anaphase I with late disjunction bridge. Fig. 5. Anaphase II with laggards and chromatin bridge.

Normal segregation of 8 : 8 at anaphase I was seen in 85%. Rarely, however, cells with 9 : 7 were also seen. In nearly 15% of the cells, late disjunction, bridges, bridge-fragment configurations and lagging univalents (Figs. 4–5) were seen both at anaphases I and II. These abnormalities result in 45% stainable pollen grains.

A few facts emerge from the foregoing observations. There are two basic numbers ($x =$ 8 and 9) in the genus *Artemisia*.[2] *A. pallens* together with *A. scoparia* and *A. vulgaris* (*sensu stricto*) are diploids based on $x = 8$. The other basic number ($x = 9$) is not only very common but polyploidy upto 6 x level is also encountered.

The lagging and unequal distribution of univalents, bridges with fragments and particularly non-disjunction bridges, may account for some pollen sterility in the species. The difficulties in terminalization, whether due to terminal non-homology or some other causes, end in deficiencies-duplications due to irregular breakage of bridges. Whether these causes would account for all the reduced seed-setting is not known. Alternatively, progressive inbreeding enforced under conditions of cultivation in otherwise outbred species, may also result in reduced seed-set. Detailed studies on breeding system are being planned to clarify the point, so as to elucidate methods for restoration of fertility. The other aspect which may also throw light on the problem is the nature of meiosis in the ovules which is totally unknown.

The author is highly indebted to Dr. S. C. Datta, Scientist-in-Charge, CIMPO, Lucknow, for the encouragement and facilities provided in the work.

Central Indian Medicinal G. N. SRIVASTAVA.
Plants Organisation,
N.B.G. Campus, Lucknow (India),
August 22, 1970.

---

1. Sheriff, A. and Srinath, K. V., *Naturwissenschaften*, 1965, **52**, 457.
2. Khoshoo, T. N. and Sobti, S. N., *Nature*, 1958, **181**, 853.

OCCURRENCE OF THE OSMOPHILIC YEAST *TORULOPSIS ETCHELLSII* IN INDIA

Torulopsis etchellsii Lodder et Rij is a facultative osmophlic yeast, occurring in substrates having high concentration of dissolved solids. Etchells and Bell[1] have made the first report of this species, isolated from fermenting cucumber brines, as *Brettanomyces sphaericus*. They have especially reported on its high salt tolerance (upto 20%) and ability to ferment highly concentrated sugar solutions (40% glucose) by this yeast. Lodder and Kreger-van Rij[2] have removed it from the genus *Brettanomyces* and assigned it to the genus *Torulopsis*. Since the name *Torulopsis sphaerica* was already occupied by another yeast, they described it as a new species of *Torulopsis*, *viz.*, *T. etchellsii*.

While screening various substrates for the occurrence of osmophilic yeasts, the author could isolate a strain resembling *T. etchellsii* Lodder *et* Rij from concentrated composite syrups obtained from sugar industry (40% sugars). The characters of the author's isolate were as follows:

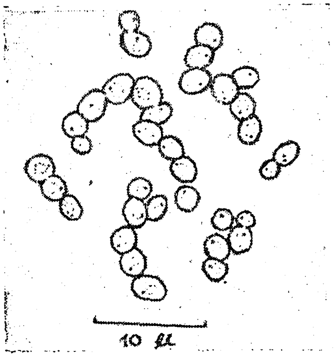
Cultural Behaviour

Growth in Malt Extract (3 days at 30° C.): Cells short-oval to oval, $(2\cdot5\text{–}3\cdot4)\times(3\text{–}4\cdot5)\mu$; single or in short chains, budding multilateral (Fig. 1), formation of sediment.

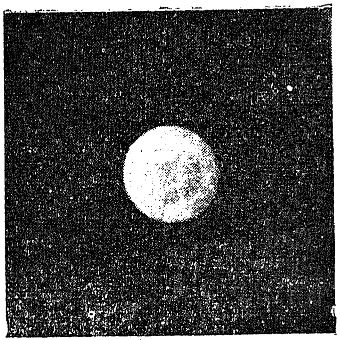
Growth on Malt Extract Agar: Same shape and size of the cells as in the malt extract.

Pseudomycelium absent.

Streak culture (8 days) on malt extract yeast extract agar: Colonies whitish, glistening, circular with smooth margin (Fig. 2).



1



2

FIGS. 1–2

Biochemical Behaviour

Fermentation: Glu +; Mal +; Gal ± very weak;
Lac —; Suc —; Raf —.

Sugar assimilation:
Glu +; Mal +; Gal ± very weak;
Lac —; Suc —; Ref —.

Assimilation of potassium nitrate: Positive.

Ethanol as sole source of carbon: No growth.

Splitting of arbutin: Absent.

Vitamin requirement test (of Schultz and Atkin)[3]:

Unable to grow in the absence of thiamine.

Although the isolate was obtained from the concentrated composite syrups from sugar factories, it cannot ferment or assimilate pure sucrose either aerobically or anaerobically. The chromatographic analysis of these syrup samples showed that besides sucrose, they contain glucose, fructose, maltose raffinose, etc. These glucose, fructose and maltose fractions could support the growth of *T. etchellsii* in the composite syrups.

It was observed that the author's collection resembled the strain 'C.B.S.Y. 920', of the type species *Torulopsis etchellsii*, except for its ability to ferment and assimilate galactose (very) weakly after prolonged incubation. Besides this, any other differences of possible taxonomic significance are being investigated. This constitutes the first report on the occurrence of T. *etchellsil* Lodder *et* Rij in India.

The author is indebted to Dr. R. S. Dhavlikar for guidance, Dr. G. B. Deodikar for suggesting the problem and Prof. M. N. Kamat for his keen interest. He is grateful to the Phaltan Sugar Works Ltd., Sakharwadi, District Satara, for the supply of the sugar syrups. He is also thankful to Shri V. C. Deo for the assistance and to the Government of India for the Scholarship during this work.

MACS Post-Graduate M. S. KUMBHOJKAR.
Res. Inst., Poona-4, *July* 31, 1970.

---

1. Etchells, J. L. and Bell, T. A., *Farlowia*, **1950**, **4** (1), 87.
2. Lodder, J. and Kreger-van Rij, N. W., "*The Yeasts—A Taxonomic Study*, North Holland Publishing Co., Amsterdam, 1952.
3. Schultz, A. S. and Atkin, L., *Arch. Biochem.*, **1947**, **14**, 369.

REVIEWS AND NOTICES OF BOOKS

Soils. By J. Sullivan Gibson and James W. Batten. (University of Alabama Press, University, Alabama), 1970. Pp. xviii + 296. Price $ 7.00.

The book is written by two experienced professors and researchers on the subject who had felt the need for such an elementary, and at the same time up-to-date text for use in secondary schools for courses on geography which include soil science. Although the book is intended for use in American schools and colleges, and so makes detail references to the soils of the United States, the presentation of the text chapters is such as to make the book readily acceptable for use in schools elsewhere also.

These chapters respectively deal with: The Nature of Soils; Factors that Affect Soil Formation; Processes of Soil Formation; Classes of Soils; Distribution of Soils; Uses and Care of Soils.

The book is illustrated, there are elementary questions at the end of each chapter and a useful glossary of terms in the end. The general reader and non-specialists will find very useful information in this readable text on Soils.

A. S. G.

Impurity Spectra of Solids. By Karl K. Rebane. (Plenum Publishing Corporation, 114, Fifth Avenue, New York, N.Y. 10011, U.S.A.), 1970. Pp. 253. Price $ 19.50.

Interactions with lattice vibrations are an important problem in contemporary solid-state theory and crystal spectroscopy. These interactions are clearly seen in the vibrational structure of absorption and luminescence spectra of activated crystals. Recently, interest has mounted up in the study of light scattering by impurities in crystals, as they play an important role in the development of crystal lasers.

This book, a revised and updated translation of the original Russian text, offers a self-contained elementary but quantum-mechanical, treatment of the present concepts and basic results of the theory of vibrational structure in vibronic absorption and luminescence spectra of impurity centres in crystals. It also covers the related problems encountered in the Mossbauer effect and the Franck-Condon principle. The book includes several dozen problems and exercises.

The book will be of interest to research workers in optics, laser physics, spectroscopy, electroluminescence and lattice dynamics.

A. S. G.

Thiamin Diphosphate and Its Catalytic Functions. By L. C. Krampitz. (Marcel Dekker, Inc., 95 Madison Avenue, New York, N.Y. 10016), 1970. Pp. 65. Price $ 5.75 or 55 *sh.*

Based on the E. R. Squibbs lectures on Chemistry of Mircobial Products, delivered by the author at the Institute of Microbiology, Rutgers, in 1968, this monograph represents the first attempt at a comprehensive summary of the mechanisms of the biochemical action of thiamin diphosphate and gives a historical development of the subject. The presentation will help orient the reader to the mode of action of enzymatic processes which require TDP as a coenzyme, as well as to describe areas of the problem which are still unsolved. The book will be of assistance to graduate students of microbiology and investigators working on coenzymes.

A. S. G.

Physics for Biology and Pre-Medical Students. By Desmond M. Burns and Simon G. G. Macdonald. (Addison-Wesley Publishihg Co., Inc., West End House, 11, Hills Place, London W. 1, England), 1970. Pp. 614. Price 75 *sh.*

The recent advances in physical science and their wide application in all fields means that nowadays biologists, doctors, and dentists are dealing with highly sophisticated physical apparatus, and are forced to know something of quite advanced physical concepts. In meeting the needs of this group of students there arise two main difficulties, firstly lack of time available for instruction and secondly, the poor mathematical equipment of the students.

The authors who are Senior Lecturers in Physics at the University of Dundee, from practical experience and discussions with the departments concerned, have brought out the first year course in physics for medical students which goes a good way toward solving these difficulties. Large portions of traditional physics have either been eliminated or only barely touched on so as to make room for topics of greater importance.

The book provides a good basic understanding of physical principles, and features a large number of applications to biological fields and medical technology. A. S. G.

Arithmetics for Metal Workers. By Engelbert Grytz. (Translated from the German). (Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1). Pp. 234.

The book is intended particularly for the practicians in the metal working industry who have to deal with technical facts, calculations and operations. The book is in two parts. The first part, of about 60 pages, deals with the elements of arithmetical and geometrical operations, and the second part forming the bulk of the book is devoted to technical facts, their arithmetic problems and their solutions. The book contains about 200 text-figures.

A. S. G.

ANNOUNCEMENTS

Award of Research Degrees

Andhra University has awarded the Ph.D. degree in Nuclear Physics to Shri B. V. Tirumala Rao; Ph.D. degree in Zoology to Shri M. Balaprameswara Rao and (Miss) P. Rama Devi.

Karnatak University, Dharwar, has awarded the Ph.D. degree in Botany to Shri B. C. Patil; Ph.D. degree in Geology to Shri B. Mahableswar.

M.S. University of Baroda has awarded the Ph.D. degree in Chemistry to Shri Vipulchandra Navrangal Dholkia and Shri Vinoobhai Nanjibhai Mistry; Ph.D. degree in Biochemistry to Shri K. K. Sakariah and Kumari Tara Vinayak Joshi; Ph.D. degree in Home Science to Kumari G. Subbulakshmi.

Osmania University, Hyderabad, has awarded the Ph.D. degree in Physics to Shri M. Venkateswarlu; Ph.D. degree in Chemistry to Shri B. Subrahmanyam, Kumari N. Hemalatha and Kumari M. Vijaya Lakshmi; Ph.D. degree in Zoology to Shrimati Indira Naga Seshaiah.

Sri Venkateswara University, Tirupati, has awarded the Ph.D. degree in Physics to Shri L. Ramamurthy; Ph.D. degree in Zoology to Shri K. Kotaiah.

Sambalpur University, Sambalpur, has awarded the Ph.D. degree in Chemistry to Shri Bikarttan Paul.

University of Kerala, Trivandrum, has awarded the Ph.D. degree in Chemistry to Shri A. G. Ramachandran Nayar.

Biology and Medical Committee Symposium, 1971, on Basic Mechanisms in Radiation Biology and Medicine

Biology and Medical Committee of Bhabha Atomic Research Centre, Bombay-85, is arranging a Symposium on Basic Mechanisms in Radiation Biology and Medicine to be held at the All-India Institute of Medical Sciences, New Delhi, during February 11th to 13th, 1971. Last dates for receipt of abstracts and papers are December 31, 1970, and January 31, 1971 respectively.

All correspondence regarding the symposium, the abstracts and the papers should be addressed to: Dr. N. K. Notani, Biology Division, Bhabha Atomic Research Centre, Trombay, Bombay-85.

University of Madras—Centre of Advanced Study in Physics—Annual Seminar

The Sixth Annual Seminar of this Centre of Advanced Study in Physics will be held at the Centre's premises from 1st to 6th February 1971. The broad field is Crystallography.

For forms and other details, contact Professor R. Srinivasan, Head of the Department, Centre of Advanced Study in Physics, Madras-25, before 20th December 1970.

Books Received

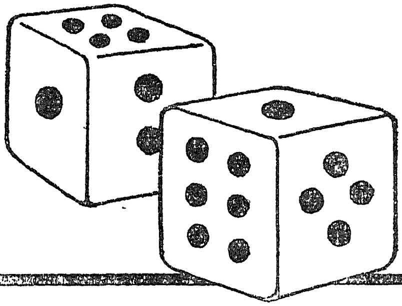
Organosilicon Hetero Polymers and Heterocompounds. By S. N. Borison, M. G. Voronkov, E. Ya. Lukevits. (Plenum Publishing Corporation, 114, Fifth Avenue, New York 10011), 1970. Pp. xxi – 632. Price $ 40.00.

Developments in Applied Spectroscopy (Vol. 7-B). Edited by E. L. Grove and A. J. Perkins. (Plenum Publishing Corporation, 114, Fifth Avenue, New York 10011). 1970. Pp. xi + 291. Price $ 12.50.

Principles of Lithogenesis. By N. M Strakhov. (Plenum Publishing Corporation, 114, Fifth Avenue, New York 10011). 1970. Pp. xii – 609. Price $ 35.00.

2447–70. Published by S. R. S. Sastry, Manager, Current Science Association, Bangalore-6, and Printed by V. J. F. Jesudason, at The Bangalore Press, Bangalore-18.

DON'T GAMBLE ON QUALITY



WHERE QUALITY IS YOUR CRITERION

insist on Guaranteed Reagents by **SARABHAI M. CHEMICALS**
for your Chemical Analysis and Research.

SARABHAI M. CHEMICALS (P.) LTD.
Post Box No. 80, Wadi Wadi, Baroda

Shilpi SM 32/70

JUST PUBLISHED

LIVESTOCK

(Including Poultry)

Supplement to

THE WEALTH OF INDIA

RAW MATERIALS: Vol. VI (L–M)

Contains sections on Cattle and Buffaloes, Sheep, Goats, Pigs, Horses and Ponies, Donkeys and Mules, Camels, Yaks and Poultry.

Covers all important aspects of Livestock and Poultry such as breeds and breeding, feeds and feeding, diseases, products obtained with data relating to production, utilization, export and import, chemical composition, preservation and processing of milk and milk products, meat and meat products, by-products, etc.

An exhaustive bibliography and a comprehensive index are also included.

This volume is useful as a reference book for both research workers as well as those interested in livestock improvement in India and elsewhere.

Pages 288 demy 4to 6 Colour plates + 30 text-figures

Price Rs. 60·00 Sh. 120 $ 18.00

Copies can be had from

Sales & Distribution Section
Publications & Information Directorate
Hillside Road, New Delhi-12